THURSDAY, DECEMBER 8, 1870

THE ECLIPSE EXPEDITION

BEFORE this reaches the hands of our readers, both sections of the English Government Eclipse Expedition will be on their way, the one to Spain and Algiers, the other to Sicily. The article in our last number will have given a general idea of the work to be done, and we think it will be admitted that seldom has so much work been laid out to be accomplished in a brief two minutes. To choose the right men for so important an investigation in a scientific point of view has been no easy task; but the list may now be looked on with satisfaction as comprising men of known ability, and of tried powers of observation in the various departments of Science concerned. Astronomy, chemistry, spectroscopy, photography, pure physics, are all worthily represented; and from our Paris intelligence this week it will be seen that there is good hope of M. Janssen being able to leave Paris to join in the Expedition.

We can now only wish for both parties that the elements will be propitious for the work they have undertaken. The time during which the observations can be made is so short that the most careful arrangements will be necessary to utilise the observing powers of every member of the party. Each will have his work definitely laid out for him. On the performance of the assigned duty without regard to other phenomena which come within the sphere of another man's work, will much of the success of the Expedition depend.

But scarcely less important than the arrangements at the moment of the eclipse, have been those of the Organising Committee, which had the charge of the preparations for the Expedition. The unfortunate delay which took place in ascertaining the intentions of the Government, threw on this Committee, after that intention was known, an amount of work compressed into the space of a few weeks, which ought to have extended over as many months. It was only in the first week in November that a definite assurance was received that an application for money and ships for the purposes of the expedition would be likely to be successful. The work to be accomplished by the Committee between that time and the first week in December, was such as those experienced in such matters might well shrink from; but, thanks to one or two individuals who had the advance of science at heart before anything else, the work has been done, and, what is more, has been well done. To Prof. Stokes in particular the thanks of the scientific world are due, for the untiring assiduity with which he has laboured to bring the affair to a successful issue.

If there is one cause for regret in the programme of arrangements, it is the absence of any one name among the observers who are going out, who can be said to directly represent the Government. It is a Government expedition, undertaken with the assistance of public money and ships belonging to the nation; and it would have been right and fitting to have seen at the head of it one of the Government astronomers, rather than that all the labour of the organisation and all the credit of the observations, should they be successful, should fall to the lot of private persons. This expedition will, indeed, form a conclusive argument against those who have held that if Government hold out a helping hand to Science, this will act as a bar to all private enterprise. Had the Government held back altogether from offering their assistance, no English expedition would have been organised; individual astronomers who felt sufficient enthusiasm to give up their time, and spend their money in furthering the ends of Science, would have been compelled to avail themselves of the generous and munificent offers of assistance from the American Government. Need we say in what light this would have been regarded by contemporary science and by future historians? Government having once stepped forward, and assumed its rightful position, a stimulus was thereby given to private enterprise; every individual concerned felt that not only the interests of Science, but the honour of his country was at stake, in doing his part towards ensuring a successful result; and probably never has an expedition been better organised, and started under happier auspices, notwithstanding what has been said to the contrary in one of the daily papers, which has evidently been misled by those who have a purpose to serve in abusing the Committee.

Now that the Government has put its hand to the work, we are bound to say it has done so in no grudging spirit. More has already been done than the promoters of the Expedition were at first given to expect. Not only has the *Urgent* been placed at their disposal, to carry the Spanish and Algerian party from Portsmouth to their destination, but a despatch-boat, the *Psyche*, is told off for the Sicilian expedition. All the foreign Governments concerned appear determined to emulate this good will; the arrangements of that of Spain we have already published. There is reason to hope that the necessary apparatus will pass through every custom-house, duty free, without the slightest impediment. It is hoped that the Sicily party may combine with that sent by the American Government, and may do their work and publish their results in concert.

Our readers need hardly be reminded of the special object which it is hoped will be accomplished by the present expedition: the settling for ever of the vexed questions concerning the luminous appearance visible in total eclipses, known as the Corona, both as to its actual locality and its constitution, which still have to be settled, notwithstanding some hard writing to the contrary. In all these observations the utmost nicety of observation will be required, and some ingenious and novel contrivances will be employed for the determination.

We shall take the earliest opportunity of placing the results before our readers. We have taken means to have a report sent to us by telegraph from every station, and shall hope to be able to summarise them in our issue of the 29th inst. These early reports will be the more valuable, as up to the present time we have no official account of the observations taken in Spain during the total eclipse of 1860. With the exception of Mr. Warren De La Rue's observations, published by himself, no results of that expedition have yet been made known to the public.

We have now only to wish the Eclipse Expedition, and every member of it, a pleasant and prosperous voyage, and a happy return to England with the consciousness of having contributed something to the progress of scientific investigation. B.

HAECKEL'S NATURAL HISTORY OF CREATION

Natürliche Schöpfungs-Geschichte. Von Dr. Ernst Haeckel. 2te Auflage. (Berlin: Reimer, 1870. London: Williams and Norgate.)

WERE there any need of evidence to show how busy in the happier times of peace the German public was with Darwinism and general Natural History topics, it would be amply supplied by the history of this work, the preface to the first edition of which was written in August 1868, and the second edition of which is now before us. The work is, broadly speaking, a popular sketch, not so much of the Darwinian theory, as of Haeckel's extension of that theory; in many respects it is a new "Vestiges of Creation," the old question being viewed from a new stand-point, and the treatment of it adapted to new feelings and new times. The old work was modestly entitled "Vestiges;" Prof. Haeckel calls his a History; and indeed a detailed comparison of the two would bring out in a wonderfully vivid manner both the progress of zoological inquiry and the change in zoological temper which has taken place in the interval between the dates of their publication.

The relation of Prof. Haeckel's extended views to the original theory of Mr. Darwin is very well indicated in a few lines of the preface to the second edition. "Darwinism is neither the beginning nor the end of the theory of evolution; it is far away removed from tending to narrow or to fix an absolute limit to further inquiry. Just as every important onward step in science becomes at once the starting-point of many new lines of advance, so Darwin's theory of selection gives immediate rise to many large extensions of the general theory of evolution; and of these my Phylogenic theories are some of the first to hand. When, then, the orthodox Darwinians cast at me the reproach that 'I go too far,' that 'I out-Darwin Darwin,' that 'by my Radicalism I do harm to true Darwinism,' I see in all such reproaches nothing but an unwilling confession that I have extended the evolution theory away and beyond the limits within which Darwin investigated the question, and have not been afraid to carry it out to its grand consequences."

In the early edition, the first six lectures are devoted to a historical sketch of the evolution theory; the creation theories of Linnæus, Cuvier, and Agassiz, and the evolution theories of Goethe and Oken, of Kant and Lamark, of Lyell and Darwin being taken as landmarks. In the second edition these chapters have been somewhat enlarged and improved, but on the whole stand very much as they were. The next five lectures (7—11) form a general exposition of the theory of Natural Selection, with discussions on heredity, adaptation, and the struggle for existence. In the second edition these chapters remain almost exactly as in the first. The same may be said of the twelfth lecture, in which a sketch is given of Ontogeny, or the development of the individual, and a comparison made between it and Phylogeny, or the development of the kind or species—in other words, Genealogy. The two succeeding chapters discuss rapidly the cosmic history of the globe, the primordial differentiation of living from lifeless things, and contains, under the title of Periods of Creation, a short sketch of Palæontology. Between these two chapters the author has, in the second edition, introduced a totally new chapter on what he calls Chorology, *i.e.* the theory of migrations, in which he discusses the influence of migration on species, the causes of migration, the effect of changes of climate, and the question of centres of creation, and points out the probable results of the Glacial epoch. The palæontological sketch is also much changed in the second edition, the "theory of ante-periods," which has found but little favour with geologists, being, though unwillingly, withdrawn.

The remainder of the volume, nearly half, is taken up with a concrete history of creation, *i.e.* with an account of how, and by what steps, all kinds of plants and animals have grown out of the primordial moners, those first existing living things which were, according to Haeckel, neither plants nor animals, but belonged to a third kingdom of Protista. This part of the work therefore is a descriptive genealogy of all living beings, the pedigree of each kind of creature being made out, or rather conjectured out, as far as present knowledge will allow.

In the second edition, as might have been anticipated, the genealogies are very much extended, and given with much greater detail than in the first; in particular, there is a new whole chapter on the migration and dispersion of mankind, and on the species and races of men. The results of phylogenic speculation or inquiry are graphically shown in elaborate genealogical trees; and a new large plate shows at one glance how all races of men have probably spread from a hypothetical paradise once situate in the great continent of Lemuria, now sunk below the waves of the Indian Ocean.

The result of criticism is shown in some few changes in the several pedigrees, but on the whole these differ in the second edition very little from what they were in the first. The Halisaurians, for instance, have been brought back to the amphibians, and the Dinosauria have been brought nearer to the birds; in fact, the whole arrangement of the Reptiles has been a good deal upset. Otherwise the still larger changes suggested by Prof. Huxley and other anatomists, are referred to, but not admitted.

In the first edition the title-page was disfigured by being opposed to a picture of heads of men and monkeys, which was at once absurdly horrible and theatrically grotesque, without any redeeming feature either artistic or scientific. In the second edition the heads have been increased from twelve to twenty-four, but their quality remains the same. As a set-off against this, however, we are presented with two really beautiful and very instructive plates of the development of several kinds of crustaceans and echinoderms, and one comparing the development of a tunicate and amphioxus. There is also a large comparative view, well worth studying, of the embryos of the four vertebrate classes at two different epochs of their development.

We have, in the above, attempted to give a general idea of what the book is, and how the second edition differs from the first, rather than to enter into any criticism. The first edition has already received the ablest criticism this country could give. We will venture, however, to make one reflection. Had the book been written for scientific men, it would have been read by some with delight, by others with feelings of fretfulness and worry, but by all with more or less of profit. Addressed as it is, however, to an intelligent and

cultivated, but still to a general and unlearned public, prone to receive fanciful analogies as real reductions to simpler laws, and to confound together fond imaginings with sound and fruitful hypotheses, we very much doubt whether it may not turn out to be an engine rather of mischief than of good. Genealogies there must be, doubtless, and many, doubtless, also may in time be made out. In cases like the pedigree of the horse, the evidence already seems wonderfully strong; and it would be simple presumption to fix a limit beyond which we cannot hope for success. Still, by their nature, genealogies are like castles of cards in the shape of inverted pyramids, with each tier less safe and less sound than the one above it. A very little memoir may disturb one of the lower stages, and then a whole pile comes down with a run. They are not the kind of things to put before learners as the strongholds of science. Some readers would learn in the first half of this volume to love Darwinism better than biology, and before they had finished the second half, would love Haeckel better than either. Others would pass rapidly through a disbelief in Haeckel and distrust of Darwin to a state of complete doubt about biology in general. Worst of all would be the effect on such minds as that of a speaker at one of the meetings of the Biological Section of the British Association at Liverpool, who said he had believed for many years in spontaneous generation, in natural selection, in the evolution theory, and in most views of a similar kind, and who seemed ready to believe anything and everything except the old truth, that truth is very hard to get, but very precious when it is gotten.

M. F.

DEFECTS IN GENERAL EDUCATION

On Some Defects in General Education. Being the Hunterian Oration of the Royal College of Surgeons for 1869. By Richard Quain, F.R.S. (London: Macmillan and Co. 1870.)

DR. QUAIN begins the present lecture with a pleasant and suggestive sketch of the career and genius of Hunter, but the greater part of it is taken up with the subject indicated in the title. The point to which most attention is naturally directed is the predominance of classics in the present system of education. Against this Dr. Quain protests with all the ardour that we expect in a man imbued with the best scientific ideas of his time. In the first place, he insists that the study of our own language and literature should hold a much more important place in the education of our youth than is actually assigned to it. He thinks it monstrous that men should be carefully taught to read Latin and Greek, and be left in almost total ignorance of the history of their own speech, with scarcely any real power of using it, and without the smallest insight into the true spirit of one of the richest and most extensive literatures in the world. Above all, however, Dr. Quain urges that Science should become the staple element of modern education. On the ground of mere expediency, he points out, rich and poor ought alike to be taught Science, for it gives the former a truer conception of the duties which attach to property, and the latter it enables to improve their position. But what is even more important, Science imparts to those who devote themselves to it the freest and largest culture; and it is grossly irreligious to talk reverently of a Creator, and yet to refuse to seize every opportunity to become better acquainted with the Creation. "If the instructors of the young in schools believe, if parents believe, that the things of this world are in truth the work of the Creator ought not that belief, without anything further, to settle the question for them? Ought not these 'glorious works' to be acknowledged as subjects for diligent study, not disregarded as they are now?" Another fault in our educational arrangements to which Dr. Quain refers is the excessive devotion to athletic sports which at present prevails. This, he thinks, arises from the repulsive nature of the chief subjects of study at our schools and universities, and would probably come right if the intellectual tastes and propensities of every order of mind were more carefully studied and gratified. The lecturer also protests against the dangerous extent to which we have carried the competitive system at the present day. With all the best writers on the subject—Mr. Matthew Arnold in particular—he believes that excessive competition is the reverse of favourable to true culture; that it renders anything like real study distasteful, and produces in the end narrow and superficial minds. He suggests that it might be well, as in Germany, to have for boys leaving school one general examination, which it would be necessary to pass for entrance to the universities to the professions, and to the public services. For this examination there would be no special preparation; it would only serve as a test of the general culture derived during a series of years from the training of skilled teachers. Afterwards the student ought to be allowed to consult his own tastes in the choice of subjects of study. The other matters of which Dr. Quain speaks, are the necessity for a higher order of masters in our national schools, and the absurdity of mixing up with strictly professional training in medical schools instruction in physics, chemistry, and botany. We hope that so thorough and exhaustive an exposure of the weak points in our educational system, coming as it does from so high an authority, will not be without its effect in quarters where there is the power, if only there was the will, to bring about a more satisfactory state of things.

OUR BOOK SHELF

The Natural History of Commerce. By John Yeats, LL.D. (London: Cassell, Petter, and Galpin, 1870.)

THE design of this book is excellent; and it has, on the whole, been well carried out. The author is well known as the principal of a large "middle-class" school, who has long recognised the claims of Science as an essential item in the education of an English gentleman or merchant. And the information contained in this volume is exactly such as ought to be familiar to everyone who lays claim to the advantages of a liberal education. We are afraid, however, that, as a matter of fact, it will be found that the "Natural History of Commerce" is a *terra incognita*, especially to those engaged in commercial pursuits, who might often derive, not only pleasure, but, what is perhaps more to the point, profit, from some acquaintance with it. The work is divided into four parts. In the first we have commercial products treated from a geographical point of view; the different botanical zones of Meyen are defined; and the principal natural products described of Britain, Continental Europe, and the other

quarters of the globe, with a supplementary chapter on Nature and Man as agents of change. The second part is descriptive of the commercial products of the Vegetable Kingdom, in which Meyen's plan appears again to have been followed in the main; it is subdivided into Food Plants, and Industrial and Medicinal Plants. In the third part we have, in like manner, the commercial products of the Animal Kingdom; and, in the fourth, raw mineral products. The comments which we have to make are almost confined to errors of omission which can be readily rectified in future editions. We regret to see still retained the antiquated classification of the Animal Kingdom into Vertebrata, Mollusca, Annulosa, Radiata, and Protozoa. The sentence by which (p. 260) the porcupine and the ant-eater are made members of the order Monotremata, is no doubt merely an oversight. Among food plants, it is strange to find no mention made of the potato, nor, indeed, of any of our culinary vegetables, the cabbage, turnip, or carrot, with the single exception of the onion! We demur to the assertion that the morel is "one of the few fungi found in this country which may be eaten with safety;" among these few we do not understand why the truffle and the morel only are given, the mushroom not being even alluded to. Indeed, the whole subject of Vegetable Products requires revision, many being entirely omitted of much greater importance than others to which considerable space is allotted. Among Industrial Plants, for instance, we should expect to find some description of the numerous fibres now used in the manufacture of paper, the esparto-grass, different kinds of wood, &c., which are daily becoming more important articles of commerce. An exceedingly useful vocabulary is appended, containing the names of natural productions in the principal European and Oriental languages; and the volume may be safely recommended as containing an immense mass of useful information on a very important subject.

Record of American Entomology for the year 1869. Edited by A. S. Packard, Jun., M.D., 8vo. (Salem, 1870 London: Williams & Norgate.)

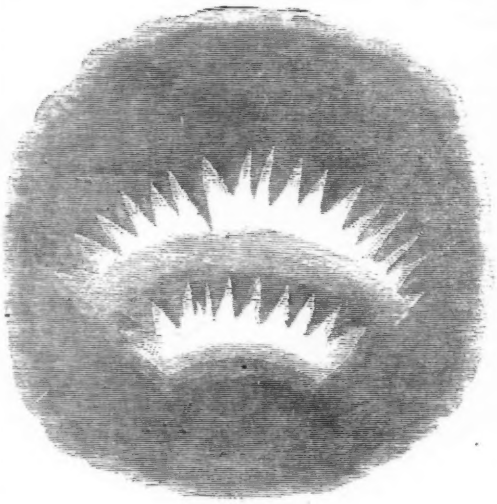
THIS is the second annual analysis of the literature of American Entomology which has been published under the care of Dr. Packard. It must be gratifying to entomologists to find that their science is so popular in the United States as to render the production of such a work at all feasible, and we can only hope that the Editor may receive sufficient support to enable him not only to continue it in its present form, but even to enlarge it and make it still more useful. Of course, with the general entomologist, this Record can never take the place of the entomological portion of the *Zoological Record* which has been brought out in this country since 1865, but it is of the greatest value in giving the European naturalist intimations of papers and descriptions published in those out-of-the-way American periodicals which rarely fall into his hands. W. S. D.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

The Aurora Borealis by Daylight

I HAVE been expecting ever since the great display of Tuesday, Oct. 25, to see some statement that the Aurora was visible on the afternoon of that day. I was in Huntingdonshire, about four miles from Kimbolton, at the time, and being out of doors at half-past four P.M., saw a remarkable pale luminous appearance some 25° above the horizon and almost due east. At this point there were two arcs of faint white lines, one above the other, both radiating outwards with a number of short points. The breadth of the upper arc (which was rather the widest) might be from twelve to twenty times the apparent diameter of the moon. It was of course broad daylight at the time, and the sky was perfectly clear and cloudless for a long distance round these patches of light. They were visible for at least ten minutes, brighter and fainter alternately, and were seen by a friend as well as myself. I was unfortunately called away, and prevented from watching them while the sky became darker. After dark (at 5.30)



they had disappeared, but the dark irregular circle mentioned by Mr. Grove, from which the streamers radiated, was extremely conspicuous. It did not strike me at the time that the appearance at 4.30 was likely to have any special interest. But as it seems that the greatest disturbance of the telegraphs happened before the *evening* display of the aurora, it may perhaps be of use to record that it was also visible in the latter part of the afternoon.

26, Finsbury Place, E.C. JAMES CUBITT

The Spectrum of the Aurora

THE following observations on the Spectrum of the Aurora were made by Mr. Alvan Clark, jun., in the neighbourhood of Boston, on the evening of October 24. He used a chemical spectroscope of the ordinary form, with one prism, and photographed scale illuminated with a lamp. Four lines were seen at the points marked 61, 68, 80, and 98. To reduce these to wave-lengths, the next day I measured the lines C, D, E, b, F, and G with the same instrument, and deduced the annexed table:—

Line.	Reading	Wave-length	Assumed Line.	Comments.	Error.
C	49·1	686			
D	57·8	589			
(1)	61	563	557	Common Aurora Line	−2·
(2)	68	532	531·6	Corona Line?	+·1
E	69	527			
b	71·2	517			
F	79·7	486			
(3)	80	485	486	F Hydrogen.	−·3
(4)	98	435	434	G ,,	+·6
G	100·5	431·2			

The first column gives the name of the line; the second the readings on the scale; the third its wave-length, obtained from Angström's chart, and by interpolation; the fourth the wave-length of the line with which these lines are supposed to be identical. The fifth column gives the name of this line, and the sixth the error in parts of the scale. The first measure is evidently wrong, and should probably have been 63. For the other three, however, the agreement is remarkable, two coming close to F and G of hydrogen, the other to the line observed

by Professor Young in the solar corona. The lines C and F having already been observed, the discovery of the line G seems to render certain the existence of this gas in the Aurora. The common methods of interpolation were not available for computing the wave-lengths of column three, on account of the large interval between the lines. A curve was therefore constructed, in which vertical distances represented scale-readings, and horizontal distances the square of the reciprocal of the wave-lengths. This, by the formula of Cauchy, should be very nearly a straight line, giving, consequently, results of great accuracy.

EDWARD C. PICKERING

ON the evening of Monday, October 24, a very remarkable auroral display was observed in New York City. In the north at first was an obscure segment, low towards the horizon, surmounted by a pale glow of light. Later, this was replaced by an extensive manifestation of beautiful streamers.

But the most notable part of the phenomenon was a band of brilliant red light, varying in its different parts constantly throughout the evening, in brilliancy, definition, and breadth, but in general some ten degrees wide. It was seen early in the evening, and could be traced from within fifteen degrees of the horizon in the east and the west, extending entirely across the sky, south of the Zenith.

The position of this rosy band viewed from the south-east corner of the Central Park, was from 8¼ to 8½ p.m., New York City mean time, about as follows.

In the east, just above the horizon, passing almost centrally, and diagonally through the figure of *Cetus*, say between δ and ξ Ceti; thence going westward it lay between *Piscis occidentalis* and γ *Aquarii*, and between *Altair* and *Delphinus*, often expanding in width beyond these boundaries. Thence it extended westward to the stars in the heads of Hercules and Serpentarius nearly to the horizon.

In all its splendid variations throughout the evening, it maintained its position in regard to the horizon of the observer standing in the locality before mentioned, the diurnal motion of the earth carrying the stars past it.

On the following evening the exhibition of this red band, in the same position, was at least equally pronounced; but without any decided boreal light, so far as I have noticed or learned.

I would also here mention the very brilliant display of variously tinted auroral streamers which engaged the admiration of members of the American Association for the Advancement of Science, as they returned by the steamer on the Hudson to the city of Troy, from their visit to Albany, from ten to eleven o'clock on the evening of Friday, August 19, 1870.

JAMES HYATT

Honey Brook, Stanfordville P.O., New York

Early Mentions of the Aurora Borealis

YOUR correspondent, Mr. Earwaker, should have mentioned that the list of appearances of the Aurora Borealis given in M. de Mairan's work is chiefly derived from another enumeration in Prof. Frobes's "Nova et Antiqua Luminis atque Aurorae Borealis Spectacula," Helmstadii, 1739. On reference to this list it immediately appears that it is very little to be relied upon for displays previous to the year 1707 or thereabouts. Some of the appearances recorded rest on no good authority, others were obviously meteoric; some occurred within the Arctic circles, others are entered twice over from inadvertence, or a neglect to allow for the difference of style; more than twenty are recorded on the authority of the meteorological diary kept at Breslau by Grebner, who in fact says nothing more than that on those occasions the night was somewhat bright (*sublustris*). When the necessary deductions on these accounts have been made, it will be found that the infrequency of the phenomena prior to 1707, and its extraordinary development since that date, are well-established facts. They are strongly insisted upon by M. de Mairan himself, who does not produce more than five instances of the aurora in France during the whole of the seventeenth century, and shows from the evidence of a missionary that it was unknown or forgotten in China until 1718. All contemporary notices prior to about this period, attest the astonishment with which it was regarded.

From the following curious passage in Sirr's "Ceylon and the Cingalese" (vol. ii. p. 117), it would appear that the aurora, or something resembling it, is occasionally visible in Ceylon:—

"There is a heavenly phenomenon which appears occasionally in Ceylon, called by the natives Buddha lights; this faintly resembles the Northern Lights, and is extremely resplendent. The priests declare this to be a sign of Buddha's displeasure when his followers have become sinful in the extreme, and that the light appears over the wihare, from whence the priests suppose the phenomenon to emanate, where those who have committed the sin which has aroused the god's anger last worshipped."

London, November 19 R. G.

IN many parts of Ireland a scarlet aurora is supposed to be a "shower of blood." In 1854 while stationed at Bearhaven, County Cork, a scarlet aurora that then appeared was said to be the blood of the people that were slain at Balaclava. About two years ago, while driving between Oughterard and Clifden, at two o'clock in the morning, there was a magnificent scarlet aurora (by far the most brilliant I ever saw), on which the car-driver remarked, "I wonder, can that be the blood of the Americans?" The late aurora is said to be the blood of the Frenchmen.

In the old Annals showers of blood are recorded at different times, always in connection with a great battle or the murder of some great chief. The earliest I can remember is that of A.D. 688, in the "Annals of Cloonmacnoise," after a battle of the Leinster-men and Ossory-men (now in the King's County, but formerly in Munster), wherein Foylcher O'Moyloyer was slain. This battle and shower of blood in the "Annals of the Four Masters," is said to have happened in the year A.D. 690. These Annals also mention that butter was turned into the colour of blood and a wolf was heard to speak; while the Annals of Tighernach place the battle in A.D. 693, and say that the blood flowed in streams for three days and three nights. During the aurora I saw about two years ago, and the two nights that the last aurora was seen here, the lakes and rivers looked to be full of blood. Therefore I should imagine the aurora of 688 must have lasted three nights, and that the people who saw it and recorded it must have had butter for supper the night it was seen, which reflected the colour.

G. HENRY KINAHAN

Geological Survey of Ireland,
Connemara, Nov. 26

Prismatic Structure in Ice

THE following extracts from a letter from Mr. Langton (whose name was, unfortunately, misread as Langters in sending his former letter to the press) may interest others as much as it has done myself, if space can be found for it in your columns. In that case, perhaps, you will kindly allow me to say a few words in reply on a future occasion.

St. John's College, Cambridge T. G. BONNEY

"I admit with you that the prismatic structure of ice on the point of melting does not appear to have any connection with the hexagonal crystals in which it is formed; and that the great analogy between the conditions of ice in that state and of igneous rocks, and I may add of clay in the process of desiccation, seems to point to contraction as the common cause. But then arises the question whether ice really does contract as it approaches the melting-point, as we know that most melted mineral matter does on cooling, and clay on drying. I am quite willing to admit that it may do so, and that, as you observe, its demeanour at a point about 32° F. has not been accurately ascertained; but if so, the fact should first be determined from independent observations before drawing conclusions from it. I am willing also to admit that I spoke loosely in my former letter when I said that the air bubbles in the process of freezing seemed to be formed in vertical lines. My object, in the concluding sentence of that letter, was to express a doubt as to there being any such contraction as you suppose on the ice approaching the melting-point, and to point out the lines of air bubbles as being the immediate cause of the structure of rotten ice. I did not then go into the origin of the bubbles, or into the cause of their being thus found in vertical lines. It is difficult to suppose that they were originally formed in those lines, for though it seems natural that the air, which is always contained in water, should be excluded on its crystallising, there does not appear to be any sufficient reason why the bubble excluded to-day should be placed exactly under that formed yesterday. Upon reviewing the whole question, I am induced to think that, as will often happen, we were both right and both wrong: that you were right in attributing the prismatic structure originally to

contraction, but wrong in supposing that contraction to be caused by an increase of temperature on the approach of the thaw, and that I was right in attributing the final break-up into prisms to the liquefaction spreading in every direction from the lines of air bubbles, but wrong in speaking of them as if they had originally been formed in those lines. We need not resort to a hypothetical contraction about the melting-point; we have a *vera causa* in accesses of cold, which will give you the desired contraction, and me my vertical lines of air bubbles. The true explanation I take to be as follows.

"After the ice has formed, and severe cold follows, it will contract, and probably equally in all directions. There is no impediment to its shrinking perpendicularly, as the whole sheet would then only be somewhat reduced in thickness; but the ice is entangled with the shores, and the whole sheet cannot contract horizontally, but relieves itself by a number of minute cracks. These are easily seen on the surface of glare ice, but one can hardly imagine that they do not more or less spread through the whole substance, and in your first letter you seem to say that you have noticed this after severe frosts. If then an air bubble comes near any such crack, it would seem natural that the direction of the crack should be diverted towards it. In fact the air bubbles, being weak points, would in a great measure determine the direction of these small fissures. Water would insinuate itself into them from below, carrying the air bubbles with it, which, upon the whole freezing, would not necessarily be exactly where they were before. A repetition of this process at frequent intervals during the winter would cause a rearrangement of the air bubbles, which one would naturally expect to find from this cause in more or less vertical lines. According to this explanation the prismatic structure would set almost from the first formation of the ice. The air bubbles would from the first be the indication of the direction of former fissures, and the lines which would determine that of new ones. As long as severe frosts continued, all other indications of the structure would be obliterated, but, as the temperature approached the melting-point, these lines of bubbles, as they formerly determined the direction of the fissures, would now be the weak points at which the thaw would commence pervading the whole mass.

"This explanation seems to supply everything that is wanted, and, upon looking back at your original letter, I am rather surprised, from the facts you mention, that you should have missed it. You say, 'I have seen it several times—in fact, *after every severe frost.*' This I have no doubt is correct; but why, then, do you say, lower down, that 'this finer structure may be found, if looked for, in *every tolerably gradual thaw*'? Again, you say that on one occasion you found the structure obliterated internally, 'except where some vertical lines of air bubbles marked the position of a tube or joint.' This exactly corresponds with what I have above supposed would be the process.

"Still, there are several points upon which more exact observations should be made before one can speak with any certainty upon the subject.

"1. Does ice contract on approaching 32° F.?

"2. Do air bubbles form from the first in vertical lines?

"3. Is there any indication, as the winter advances, of a rearrangement of the bubbles, as that they run into each other, and get more and more ranged in vertical lines?

"4. Is there any indication in the earlier stages of the ice, that, after a night's hard frost, the cracks seen on the surface spread through its substance? And if so, to what extent do they follow the lines of air bubbles?

"5. If a block of ice is cut early in the winter, before the prismatic structure from contraction with cold has commenced in any noticeable degree, and when it is no longer in a position in shrinking to crack in one direction more than another, to what extent does that structure afterwards develop itself?

"As there has been this one point in the behaviour of ice in which we have both taken an interest, I am induced to mention some other peculiarities which have come under my notice, with regard to some of which I have not even attempted to suggest an explanation. Several years ago I lived on the shores of a lake in the backwoods, and as in those early days the ice in winter and a canoe in summer formed one's only means of locomotion, one naturally thought a good deal about ice in its various stages of formation and decomposition. I lived about two miles below the head of the lake, where a river fell into it, upon which was a considerable fall, and which connected it with another much deeper lake, about a mile above. The effect of the stream was felt for a considerable distance into this lower lake, which was narrow at its head, and the ice was never safe there; indeed, excepting in the very severest frosts, there was as it were a bay of open water extending into the ice almost as far down as my house. But when the ice first formed in the fall it invariably took over the whole lake, even on that part which was afterwards open water during almost the whole winter. Indeed, upon one occasion, upon getting up in the morning I was astonished to see ice formed exactly on that part which was usually open water, whilst the rest of the lake, which was usually closed, had no ice upon it at all. Very soon after the sun rose that ice disappeared and the lake did not freeze over for a week after. The first ice, which always formed over the whole lake, would generally remain till there was a fall of snow on it, soon after which it would disappear where the effect of the stream was felt. The first winter I was there I nearly suffered from ignorance of this habit of the ice. I had occasion to cross the lake, which had been closed for some days, and had received a pretty thick coating of snow in the meantime, and, knowing that the ice must be pretty thin, I took the precaution to wear snow shoes. After a while I felt a peculiar sinking of the snow shoes, and observed that the track filled with water, and upon feeling with a stick I carried, I found no resistance of ice at all. I was, in fact, walking upon little more than a cake of snow. You may imagine that I at once made a little circuit and did not stop till my stick encountered good ice, and an hour or two afterwards that part of the lake was open water. Now I think I can explain this peculiarity of the early formation of ice where no ice remained during much colder weather in the winter. I take it that the whole surface, at least, of the water in my lake, which was rather a shallow one, had been reduced to 32° F., or nearly so, and that on a very cold night the water from above, being thoroughly exposed to the cold in coming over the fall, had been reduced even lower, so that when it reached the comparative quiet of the lake, where it naturally floated on the surface, it became ice for a short time that morning I spoke of, though it could not long maintain that condition. So also on ordinary occasions, when all the lower lake was ready to freeze, the water, thoroughly cooled at the fall, would freeze also, although the lake above had not yet been frozen over. At the foot of the upper lake, immediately above the fall, was a very shallow bar, so that the only part of the upper water which would come over would be the coldest layer on the top. But after the upper lake had frozen over also, and had received its coating of snow, very little more cold would penetrate to reduce the temperature of the surface, and the lake being very deep, and receiving fresh accessions of heat from below, the water would soon get considerably above the freezing-point, and with the aid of the friction of the stream would thaw away the snow-covered ice below with which it first came in contact. One is inclined to ask why the complete exposure of the water to the cold in coming over the fall, which I have supposed to reduce the temperature so much in the beginning of winter, had not the same effect in the severer cold afterwards; but the water which came from under the snow-covered ice would probably be much warmer than that which formerly came from the surface of the open water, and moreover the spray soon formed ice, which gradually crept over the shallower parts of the fall at its edges, and the exposure and its cooling effect may not have been as complete as at first. I cannot say that I am altogether satisfied with my explanation of the curious anomaly that a part of the lake would freeze over at a temperature of 20°, which would remain open when it was far below zero; but such are undoubtedly the facts.

"If there was this anomaly in the first formation of the ice, its sudden disappearance in the spring, which I mentioned in my former letter as giving rise to the popular prejudice that it sinks, was almost equally astonishing. Upon one occasion the ice was evidently in the last stage of decomposition, and I had got my canoe ready for a journey in the morning, when I fully expected the lake would be open; but before starting, I wanted to go to the two or three houses at the fall, which we dignified with the name of a village. Although the lake at my landing was an unbroken sheet of honeycombed ice, which had even borne me early in the morning, the open water extended to a point about half a mile above me, and I determined to carry my canoe so far through the woods. I cannot have been a quarter of an hour in doing so, but when I launched my canoe beyond the point, there was not a vestige of ice down as far as my landing, though I still saw it across the whole lake a little farther down. Being anxious to see the process of the actual disappearance, I turned my canoe down the lake, and paddled as fast as

I could; but long before I could get to where I had seen the ice, the whole lake as far as my view extended was open water. This almost instantaneous disappearance of a body of ice more than a foot in thickness can only take place in perfectly still weather. If there is any wind it breaks up, and the fragments are driven up against the ice which still holds together, and into the shores, where the rapidity with which it melts is not so striking. I never was fortunate enough to be actually in at the death.

"There are also some curious facts connected with the air-holes which form themselves during winter. There are often particular spots where partial openings in the ice will be formed every winter. These I conceive to arise from warm springs, and to have no connection with air-holes properly so called, which are not confined to any particular locality, but may appear anywhere. There is always a good deal of air under ice, and you may often see it scattered about in small bubbles when the ice is thin. It is probably air excluded in the process of crystallisation, and when there is added to it sundry gases formed from decaying matter in the water, it amounts during the winter to a considerable quantity. Such collections of air, like the bubble in a spirit-level, are in a very uneasy condition, and are rapidly transferred from one place to another on any casual disturbance of the level, giving rise to one of the numerous noises which are always more or less heard on a lake covered with ice—at least, we used always to attribute to this cause a peculiar groaning sound which was very common. Now, if there should be any casual inequality in the lower surface of the ice, the air will naturally collect there, and if it is above 32° F, which in so far as it consists of evolved gas it probably will be, the receptacle will be increased by thawing. A dome-shaped cavity will thus be gradually formed, which will finally reach the surface; air will escape from below, and the surface-water, of which there is almost always more or less after the snow has fallen, will run down from above, wearing the little jagged channels which are characteristic of air-holes. The whole thing will then after a while freeze up again, leaving an indication of where the air-hole has been in the different colour of the freshly-formed ice. I have tried several such air-holes with an axe when first formed, and have always found them to lead to such a dome-shaped cavity. I remember on one occasion an otter frequenting a large air-hole which remained open for some time, and which must have been from a mile and a half to two miles distant from the nearest open water. How did he reach it? for no otter can travel that distance under water without access to air. The Indians say that they will go to greater distances still under the ice, and that they always find air there. It is likely enough that there may be many such dome-shaped cavities, which have not yet reached, and may never reach, the surface as air-holes, but one would imagine the air they contain to be not of the most wholesome character. However, this otter did frequent that air-hole for about a week, which it certainly did not reach by travelling on the ice, and though it had few chances of breathing there, in the daytime at any rate, it contrived during that period to elude the snares of a white man and an Indian, who wasted a good deal of time in looking after it.

So far, the process of the formation of air-holes, if I am right in my explanation, is intelligible enough; but sometimes they are formed in a manner which is difficult to account for. Upon one occasion I had crossed the lake to a friend's house, about four miles off, and we had determined to start together next morning to our nearest town, but I had to go home first. I first went over by daylight, when there certainly was nothing unusual in the appearance of the ice, which might be four or five inches thick at the time, with a slight sprinkling of wettish snow on it. I returned home about eleven at night, and, as it was bright starlight, with only a few floating clouds, I should have noticed any change; but I came straight across, and saw nothing to attract attention. But when I crossed again at daylight in the morning, in one part of the lake the whole surface was covered with air-holes—there must have been hundreds of them. At first I gave them rather a wide berth, but, on approaching one to examine it, I found it frozen up again, the clear ice in the hole, with very slight indications of the characteristic jagged edges, being the only sign that there had been an open air-hole there during the night. I had no axe with me to try whether they were connected with any cavity, but the appearance was as if holes of from two to five or six inches in diameter had been punched through the ice. Of course, we attributed it to electricity, as people will do anything which they do not otherwise understand, and I have never been able to give any more intelligible explanation of the phenomenon. There certainly had been some faint sheet lightning that night, a very unusual thing in winter; but what connection, if any, there may have been between the two things, I cannot tell.

"Ottawa, Sept. 15" "JOHN LANGTON

The Difficulties of Natural Selection

I FIND, on looking again at Mr. Bennett's article, that I have misrepresented him on one point, for which I beg to apologise. On his supposition, that the first twenty possible steps on the road to mimicry are absolutely useless, his argument will have some weight. This supposition, however, is entirely unsupported by facts. Very large variations of colour are exceedingly common in butterflies; and when such variations are in the right direction, they must in some cases be useful. I believe myself that far less than fifty, or even twenty, steps of variation would in some cases produce very good mimicry.

ALFRED R. WALLACE

Cave-paintings by Bushmen

MY friend, Mr. George W. Stow, of Queenstown, South Africa, refers in a letter to the interesting subject of the old cave-paintings by the Bushmen, as follows: "During the last three years I have been making pilgrimages to the various old Bushman caves among the mountains in this part of the colony and Kaffraria; and, as their paintings are becoming obliterated very fast, it struck me that it would be well to make copies of them before these interesting relics of an almost extinct race are entirely destroyed. This gave rise to an idea in my mind of collecting materials enough to compile a history of the manners and customs of the Bushmen, as depicted by themselves. I have, fortunately, been able to procure many fac-simile copies of hunting scenes, dances, fightings, &c., showing the modes of warfare, the chase, weapons, disguises, &c. This promises to be a collection of very great interest. In some places it is astonishing to what a degree of perfection some of the wild artists had arrived. I have found three different series of paintings, one over the other; and, as the most recent must be upwards of fifty years old, the undermost are most probably very ancient. The colours are very permanent, and would last for ages if not wantonly obliterated. Unfortunately, the Kaffir herds and others are constantly destroying them, and, by the time another generation has passed, few remains of them will be left."

The pigments used in the caves were derived from ochreous concretions abounding in some of the sandstones of the Karoo series of the interior of South Africa, as in the Rhenosterberg, Stormberg, and elsewhere. These concretions, when broken open, supplied the natives with paint-pots, and from among the several colours of yellows, browns, reds, &c., the chocolate was selected for painting the human form in the caves.

T. RUPERT JONES

5, Terrace, Yorktown, Surrey

A Rare Fish

A SPECIMEN of the Silvery Hair-tail (*Trichiurus lepturus*) was taken this morning at Seaton. It measures 2 feet 2 inches in length, and is in very good preservation, being only slightly injured on one side of the head. A specimen from the Collection of the late Mr. F. W. L. Ross, in this museum, is about the same size, and was taken on 6th August, 1852, off the Start Point, Devon. The recorded instances in which this remarkable fish has occurred on the British coasts are very few, and the specimens obtained have generally been much injured. The present specimen was brought to me to name by Mr. Frank Gosden, of the West of England Fish and Game Company, Queen Street, Exeter.

W. S. M. D'URBAN, Curator

Devon and Exeter Albert Memorial Museum,
Queen Street, Exeter, December 3

The Ceratodus Forsteri

I AM much obliged to Dr. Sclater for his remarks on the new fish discovered by me as *Ceratodus forsteri*, and I take this opportunity to inform your readers who may feel interested in this matter, that I spoke of the animal as an amphibian, principally because it is in the habit of leaving the water during the night. The works to which Dr. Sclater refers me are not at my command, and I adopted the generic term of *Ceratodus* because

the bulk of my specimens greatly resemble those of the above fossil genus. Professor Agassiz has written to me to say that the discovery of the *Ceratodus forsteri* is of the greatest importance, and that he (Prof. Agassiz) is "amazed" at it. By this mail two of these interesting strangers (with intestines) will be shipped to England, as a present from Prof. A. M. Thomson to Prof. Owen, another by Mr. Ramsay to Dr. Sclater. I am glad to see that my friend Ramsay has complied with Dr. Sclater's request, and ceased classing the *Ceratodus* as "Salmon," which he confesses to have done frequently before. Mr. George Masters, the assistant curator of the Museum, is now at Gayndah, with appliances to catch the fish, and he will, if possible, send some alive to Sydney and to the Zoological Society of London.

Sydney, Sept. 7 GERARD KREFFT

The British Museum Collections

As it is proposed to remove the Natural History collections from the British Museum to Kensington, I hope care will be taken to make the collections as serviceable as possible to students. In particular the British Department might, with great gain to all, be extended and improved. There is now but one small room devoted to British zoology, and this interesting branch of science is poorly represented by a selection of species not always well chosen nor even strictly indigenous. Still, imperfect as it is, I believe this is the only attempt to present a comprehensive view of the British fauna in London. In the new buildings it is much to be desired that a large and well-lighted gallery should be devoted to the zoology of the British Islands, and as complete a collection as possible exhibited. The specimens should be labelled with local as well as scientific names, and, when desirable, short interesting particulars might be given, as on the labels of the art collection at South Kensington. I think no part of the museum would be so well frequented or so generally appreciated by the public. When the labour of removing the collections is over, I hope we may be furnished with catalogues of different departments, with notes of the time and mode of acquisition, &c., of the most important specimens. If begun for the British collections, it might afterwards be extended to the rest of the museum. The nation, which possesses such truly choice and extensive collections, ought to take care that the advantages to be reaped from them are fully developed and placed within the reach of all. A. W. L.

Glass Floats off the Isle of Lewis

THE glass globes to which you refer as having been found on the shores of Lewis, are no doubt fishing floats. The Bergen fishermen have recently begun to use such balls as floats for their nets, and they are occasionally picked up in the North Sea. Those which have been brought to this office were empty, *i.e*, contained no liquid, and bore no distinguishing mark at all. They were picked up about 100 miles S.W. of the Loffoden Islands.

116, Victoria Street, London, S.W. ROBERT H. SCOTT

P.S.—If any of the globes are sent to me, I shall be happy to inquire in Norway about them, and return them, after inspection, to their owners.

The Milky Way

YOUR correspondent, Mr. Jeremiah, after quoting the words of the Llangadock "Oracle," adds, "meaning that the wind will blow from that quarter." Did Mr. Jeremiah interpret the man's meaning correctly? If so it is at variance with a popular belief in Hampshire, *viz.*, that in whichever way the Milky Way may be seen over night, the wind is sure to blow *across* it, or at right angles to it on the following day. HENRY REEKS

The Cockroach

IN some ships infested with these insects, sailors frequently complain of having their toe and finger nails, and the hard parts of the soles of the feet and palms of the hands, nibbled by them. The men have exhibited to me their nails and skin, which had the appearance of having been attacked. I can vouch for the following, as I was the unhappy subject of it. On returning from a shooting excursion in salt swamps in tropical Australia, with my feet blistered and sodden, I was put to sleep in a room swarming with cockroaches (the small species). The night was intensely hot, and my feet were exposed. I had slept soundly for some hours, when an intolerable itching and irritation about my feet awoke me. I felt these objectionable insects running over and gnawing at my feet. On striking a light, I found they had attacked the skin, and entirely eaten it away from a large blister, leaving a raw place as large as a shilling. I slept again, and in the morning found they had completed the work, and established a painful sore. The whole of the hard skin on the heel was also eaten down to the pink flesh. The nails were not attacked. I have now, at a distance of four years' time, bluish scars on the skin.

Mill Hill, Nov. 11 ARTHUR NICOLS

I HAVE to thank the Rev. W. Houghton for his references on this subject, and to explain that I wrote Aristotle inadvertently for Aristophanes. My only objection to adopting σίλφη as the Greek equivalent for our cockroach is that the unpleasant smell which is mentioned as a characteristic of the former, is not particularly marked in the latter. If we adopt the view that the cockroach was known to the ancients, we must, of course, reject Gilbert White's story of its American origin, and, as he thought, its recent introduction into England. C. J. R.

KAIETEUR WATERFALL, DEMERARA

THE great Kaieteur Fall, recently discovered by Mr. Brown, has a clear descent, according to barometrical observations, taken simultaneously by Mr. Brown at the bottom, and by Mr. Mitchell, at the top, of 750 feet. Above, the Potaro glides smoothly in a slight depression of the table of conglomerate sandstone, and disappears over the edge in a body, which is estimated at eighty yards in width, and of depth uncertain in the centre, but shallowing rapidly towards either bank. When the Fall was discovered in April, the rocky channel was completely covered, and the stream must have had a width of, at least, 100 yards. During the summer it is diminishing in volume, and, as the Indians state that it will continue to do so till October, only the central and deeper portion, about one-third of the whole, will then remain. The best time, therefore, for a visit is in spring, at the end of what appears to be the rainy season of this elevated tract.

As the Fall was seen by the exploring party who discovered it, nothing can be imagined more beautiful. The central portion, which is never dry, forms a small horse-shoe, or re-entering angle, and the water in this part preserves its consistency for a short distance from the edge. But everywhere else, and here also at a few feet from the top, all semblance of water disappears; it breaks up, or blossoms, into fine foam or spray, which descends in the well-known rocket-like forms of the Staubbach and similar waterfalls, but multiplied a thousand times, into a small dark pool, over a semicircular curtain. The cavern behind the Fall is the home of thousands of swallows, which issue from it in the morning, and may be seen returning in their multitude at night. The Fall itself is one vast descending column of a fine, dry-looking, snow-white substance, bearing a resemblance in colour and consistency to the snow of an avalanche, but surpassing all avalanches in size and in the beauty of the forms taken by the material as it falls. Rainbows of great splendour were observed, one from the front of the Fall in the morning, one from the summit in the afternoon; but this last reverted, forming a coloured loop or ring, into which the whole mass seemed to precipitate itself, and disappear and dart out underneath, black and foaming at the gorge and outlet of the pool.

Eleven days were spent in ascending the Essequibo, which was heavy in flood, and detained the party double the time anticipated; five days brought them from Tomatomari, the lowest fall on the Potaro, to the Patamona village. In this stage there are five cataracts, two of which, at least, are inaccessible. Two days were occupied in visiting the foot and summit of the Fall, and in descending to the Settlement, leaving Messrs. Brown and King to complete the survey and sketches of the country in four days and a half.

QUERIES RESPECTING ÆTHER

THE following speculations first appeared in the pages of the *Engineer*:—

When light and caloric were supposed to have a material existence, the hypothesis of the universal existence of a highly elastic medium was unnecessary, since matter might with the utmost freedom be projected through vacuous space; but as light and heat are now generally admitted to consist not of transmitted matter, but of transmitted vibratory motion (and why may not electricity, so freely interchangeable with the former, be admitted into the same category?), the necessity of the existence of a transmitting medium, pervading infinite space, becomes at once apparent; and this medium, hitherto not cognisable to our senses, has been termed æther.

But it has been further assumed that æther is alone capable of transmitting the extremely rapid vibration of light and heat, and that it must therefore necessarily pervade or permeate all kinds of sensible matter. The questions proposed to be raised in this communication are the necessity of this interstitial hypothesis, and the probable capability of ordinary matter to transmit the vibrations of light and heat.

It is now generally admitted that when a body becomes heated, its own particles, and not those of the supposed interstitial æther, are thrown into a state of vibratory motion, the amount of heat corresponding probably to the amplitude of the vibrations; hence a certain amount of energy has been communicated to those particles, and, at all events, in the case of celestial mediations, the molecules of æther must previously have possessed the energy or *vis viva* which they have communicated. Hence æther, being susceptible of *vis viva*, has recently been admitted to be ponderable, but this admission is not a necessary consequence, for although the idea of the existing energy is associated with that of weight, in consequence of the constant energy acquired by gravitation having been taken as the measure or unit of energy, however acquired, there is no necessary connection between them. Suppose, for example, a flea were placed on an orbilating planet of the size of a pumpkin, while its muscular energy would remain undiminished, its weight would be infinitesimal, and the first leap would obviously plunge it into infinite space, to perform subsequently, perhaps, an independent orbit.

Further, it has been shown from the investigations of Mr. Norman Lockyer, to whom the progress of solar physics is so largely indebted, that incandescent gases are capable of initiating vibrations of definite periods, which are, moreover, occasionally accelerated or retarded by the proper motion of the emitting gas. What reason can there then be for doubting that gaseous matter is capable of transmitting heat waves, and if so, of likewise transmitting the waves of light, since the two are so intimately connected by the identical phenomena of reflection, refraction, and polarisation? May not in fact, in some instances, the perceptions of light and heat be but different sensuous impressions produced by the same vibrations?

The only basis on which the interstitial-æther hypothesis rests is the assumed incapacity of ordinary matter, whether in the solid, liquid, or gaseous state, to transmit the vibrations of light and heat, because the only vibrations, namely, sonorous, with which we are acquainted, are almost immeasurably slower than those of light and heat, the one being numbered by at most a few thousands, the other by hundreds of millions of millions in one second of time.

But it must be borne in mind that sonorous vibrations are always longitudinal, in the production of which repulsive forces are alone concerned; whilst, on the contrary, light and heat vibrations are necessarily transverse, and the production of these is solely due to attractive forces. Now these respective forces obey very different laws, for whilst attractive forces obey generally, and probably universally, the laws of the inverse square of the distance, molecular repulsion must obviously, at all events in gaseous matter, obey the laws of the inverse cube of the distance; therefore, from the rate of transmission of longitudinal vibrations, nothing can be predicted respecting the rate of transmission of transverse waves. It has been asserted that molecular repulsion is a dynamical resultant effect, and, therefore, incapable of expression by a statical law; but it is very doubtful whether molecular attraction is not equally a dynamical sequence, and, therefore, not a whit more entitled to claim a statical law than the former. Now, in the denser forms of matter, namely, the solid and liquid, it appears that the wave-lengths of created transverse vibrations are indefinitely modified, probably by the more energetic action of repulsive forces; for whilst any given kind of matter in the solid or fluid state is found, when incandescent, to emit light and heat waves of all lengths, and so to form a continuous spectrum, the same matter in the form of incandescent gas will emit only a few sets of waves of definite and invariable lengths; and, moreover, some of these wave-lengths are frequently found to bear very simple numerical ratios to each other. And even in gaseous matter it has been observed that the bright lines in the spectrum become narrower and more sharply defined by rarefaction; and, on the contrary, broader and less defined by condensation. Moreover, as regards density, the absorption bands in the spectrum appear to obey the same law as the bright lines. In other words, every kind of matter appears to be capable of emitting or absorbing its own peculiar waves, according to its tenacity; that is, as the results of molecular attraction are less and less interfered with by those of repulsion. The well-known peculiar incapacity of any given translucent substance to transmit the heat rays emitted by a heated portion of the same substance; or, in other words, the ability of the molecules to freely appropriate the wave motion that has been induced by some intervening medium by similar molecules, seems further to argue that ordinary matter is capable of assuming vibrations having the extreme rapidity of those of light and heat. And that there exists no valid ground for a distinction between light and heat in this respect is further confirmed by the experiments of Prof. B. Stewart, who has shown that the emission of light by incandescent bodies closely corresponds with their absorptive power (whether selective or otherwise) when not incandescent; and, further, that even in the decomposition of light into true polarised beams by the tourmaline it emits, when incandescent, the ray that is otherwise absorbed.

Can there, then, be any valid reason for doubting the ability of ordinary matter to transmit those transverse vibrations, which it is obviously capable of either absorbing or emitting: and if so, what ground is there for the hypothesis that the transmission of light and heat waves necessitates the presence of imperceptible æther in the interstices of perceptible matter?

If the existence of æther in infinite space, essential to the undulatory theory, be admitted, it may be asked, how is it possible to conceive its exclusion from any portion of space? A very simple hypothesis propounded by the writer in the introduction to the last edition of his "Elements of Physics" will meet this difficulty, namely, that æther (like its fluid namesake with water) is *immiscible* with known gaseous matter. This, it must be admitted, is sheer hypothesis; but if true, it must ever remain so, as being beyond the reach of human ken. But of this we may rest assured, that if it be not wanted in and around even our corporeal frames, it is not there; the contrary supposition would be inconsistent with the infinite wisdom of the Creator of the universe.

CHARLES BROOKE

SPECTROSCOPIC NOTES*

A NEW FORM OF SPECTROSCOPE

THE instrument, a description of which follows, was designed for attachment to the equatorial of 6·4in. aperture and 9ft. focal length, belonging to the observatory of Dartmouth College. It is especially intended for observations upon the solar spots and protuberances, and accordingly the principal object kept in view has been to combine a very high degree of power with compactness, lightness, facility of manipulation, and firmness of construction. Having the dispersive power of 13 prisms of heavy flint, each with an angle of 55°, it yet weighs less than 15lb., and measures over all 15in. in length, 8in. in breadth, and 4½in. in height. It was make by Alvan Clark and Sons.

The accompanying plate (Fig. 1), taken from a photograph, gives a correct idea of its appearance and general arrangement. The collimator and observing telescope have each an aperture of ⅞ths of an inch, and a focal length of 7in., which might advantageously have been increased to 12in. were it not for the necessity of compactness.

The light from the slit, after passing the collimator, is transmitted through the lower portion of a train of six prisms of heavy flint glass each 2¼in. high, and having, as stated above, a refracting angle of 55°. A seventh *half-prism* follows, and to the back of this is cemented a right-angled prism, by which, after two total reflections, the light is sent back through the upper part of the same train of prisms, until it reaches the observing-telescope. This is placed directly above the collimator, and firmly attached to it. Finally, a diagonal eye-piece brings the rays to the eye in a convenient position for observation.

The instrument has thus the dispersive power of thirteen prisms, and even with the low magnifying power of only five on the observing telescope, shows perfectly the lines of aqueous vapour, which make their appearance between the sodium lines when the sun is near the horizon. Of course, everything shown on the maps of Kirchhoff and Angström is readily seen with it, and many lines besides.

Its definition is very beautiful, and the only optical fault of the instrument seems to be a curvature of the lines, resulting from the shortness of the collimator.

After planning the instrument, I learned that the same idea of sending the light twice through the prisms by a right-angled

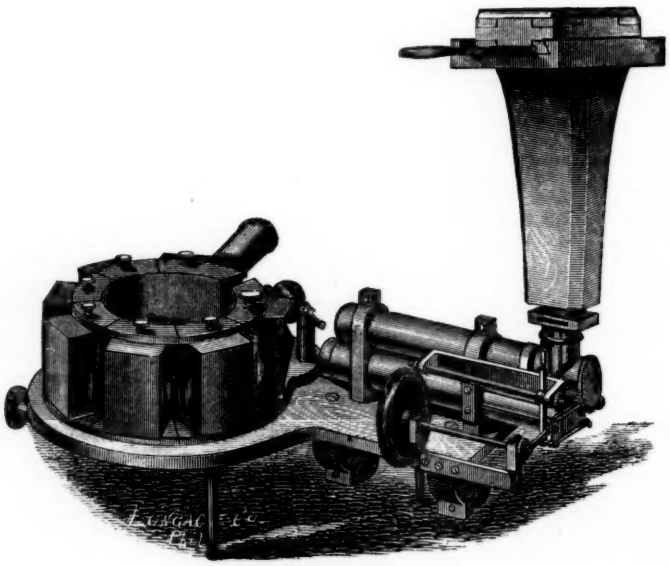


FIG. 1.—A NEW FORM OF SPECTROSCOPE

prism at the end of the train had also occurred to Mr. Lockyer and others; but I do not know that it has yet been put in practice elsewhere.†

The prisms, for protection and convenience of handling, are set in frames of blackened brass. They are arranged around the circumference of a hollow cylinder of elastic gun metal, 3¼in. in diameter, with stout flanges above and below, between which they are clamped by little thumb-screws, so that they can be readily removed or transposed: it requires less than a minute to put the last prism with its reflector in place of any other of the train, thus reducing the dispersive power to any extent desired.

No particular care is required in placing the prisms, as a couple of narrow flanges were cast upon the cylinder near the top and bottom, and afterwards planed off to form true bearings for the backs of the prisms. They are thus always correctly set by being simply slid home before tightening the clamping screws.

The lower flange of the cylinder is attached to the base-plate by a screw directly under the middle of the front face of the first prism. Around this point as a centre the whole system of prisms is movable by means of a double-threaded tangent-screw, which brings the different portions of the spectrum into the field of view. The adjustment of the prisms to their angle of minimum deviation is effected by a method devised by Mr. George Clark, which is exceedingly simple, and, if not theoretically exact, answers every practical purpose. The flanges between which the prisms are clamped, are sawed through between the prisms, and a portion of the cylinder, flanges and all, equal to an arc of about 30°, is cut out between the first prism and the last. On closing up or spreading open this gap by means of a suitable tangent-screw, the circumference of the circle around which the prisms stand is correspondingly enlarged or diminished. Probably, when the ends of this opening are drawn very near together, or spread very far apart, the cylinder is somewhat distorted, and a corresponding mal-adjustment of the prisms results; but if so the effect is very slight.

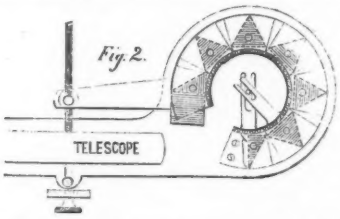
The instrument gives a perfect view of every part of the spectrum from below A to H: above *h*, however, when all seven prisms are used, there is a loss of light occasioned by a partial obstruction of the apertures of the collimator and telescope by the corner of the reflecting prism.

* From the Journal of the Franklin Institute.

† An instrument exactly similar in all essentials to the one here described has been used by Mr. Lockyer for more than a year past.

Were it important to secure the perfect cylindricity of the prism-frame through the whole range of adjustment, it could be easily done by merely fastening at the back of each prism a radial bar acting upon a central pin, as in the arrangement first devised by Mr. Rutherfurd, and since adopted by Mr. Browning, in his automatic spectroscope.

This plan of Mr. Clark's, doing away with all joints and hinges, has the great advantage of perfect firmness and solidity in every



position of the instrument, an advantage hardly to be overrated in an astronomical spectroscope.

Had it occurred to me in season I might have made the instrument still simpler, firmer, and perfectly automatic in its adjustment, by merely substituting for the first prism a half-prism,* like the last of the train, to which the right-angled reflecting prism is cemented.

Placing the first half-prism with its front face perpendicular to the line of collimation, it would never need to be disturbed ; the flange of the cylindrical frame which carries the prisms would be firmly fastened to the bed-plate immediately beneath it, and the pivot joint at this place with the corresponding tangent-screw would be dispensed with. The only adjustment required would be that produced by the screw which is now used to adjust for minimum deviation by opening or closing the gap of the cylinder.

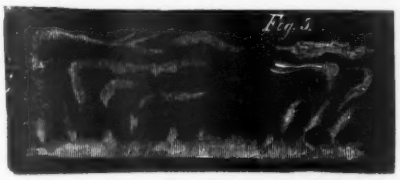
Of course, this arrangement would reduce the dispersive power of the train by the amount of one prism, a loss easily made up by adding a degree or two to their refracting angles.

Fig. 2 exhibits the plan of the proposed arrangement, and requires no explanation, unless to remark that for the sake of distinctness I have represented only two of the radial bars which may be used to render the adjustment accurate.

* On returning from the Eclipse Expedition my instrument will be made automatic in accordance with this plan.

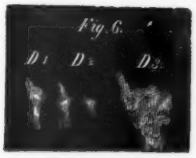
It might be better to place the face of the first prism not exactly normal to the line of collimation, in order to avoid repeated reflections between it and the object-glass of the collimator, which would be likely to produce a troublesome ghost, or the same thing might be accomplished by simply cementing the object-glasses of both collimator and observing telescope directly upon the front of the prism ; this would make the instrument still more solid and compact.

The eye-piece of the instrument has an apparatus attached, which, however, thanks to the high dispersive power, I find unnecessary.

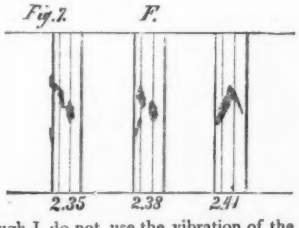


It was early proposed by Janssen to use a vibrating or rotating slit in order to make visible the form of a solar prominence, but as Zöllner has shown, the mere opening of the slit answers just as well, the light of the protuberance being diluted to precisely the same extent in either case.

It occurred to me in connection with a suggestion of Professor Morton, that by interposing at the focus of the eye-piece a diaphragm which should move with the vibrating slit, the light of the neighbouring portions of the spectrum might be cut off and this dilution avoided. Mr. Clark has devised and constructed a very beautiful mechanical arrangement by which this simultaneous and accordant motion of slit and diaphragm is effected by the rotation of the small fly-wheel shown in Fig. 1.



But I find, that although seen in this way, the prominences appear very bright ; yet the working of the apparatus always causes a slight oscillation of the equatorial, which interferes with the definition of details, and I prefer to work with the slit simply opened. When the air is free from haze, the whole extent of a prominence 30,000 miles in height is readily examined through the C or F line, and the most delicate details reveal themselves with a beauty and clearness of definition which even yet always surprises me, and speaks most emphatically for the exquisite workmanship of the 43 different surfaces by which the light is either refracted or reflected on its way from the slit of the collimator to the eye.



But, although I do not use the vibration of the slit and diaphragm, I find the mobility of the slit so convenient as to be practically indispensable. In examining the spectrum of a group of sun-spots, for instance, it is very much easier to move the slit to the particular point we wish to observe, than to move the solar image by the tangent screws of the equatorial.

Photographs of the Solar Protuberances

The protuberances are so well seen through the F and 2796 (near G) lines, that it is even possible to photograph them, though perhaps not so satisfactorily with so small a telescope as the one at my command. Some experiments I have recently

made show that the time of exposure, with ordinary portrait collodion, must be nearly four minutes, in order to produce images of a size which would correspond to a picture of the solar disc about 2 in. in diameter. This length of exposure demands a more perfect clockwork than my instrument possesses, and a more accurate adjustment of the polar axis than it had during the experiments, as well as a steadier condition of the atmosphere.

Thus far, therefore, I have not been able to produce anything which could properly be called a good picture. Negatives have been made which show clearly the presence and general form of protuberances, but the definition of details is unsatisfactory. This amount of success was reached upon September 28, when impressions were obtained of two protuberances on the S.E. limb of the sun, and, slight as this success was in itself, I consider it of importance in showing the perfect feasibility of going much further with more sensitive chemicals, more delicate adjustments, and greater telescopic power. I was aided in the experiments by Mr. H. O. Bly, our local photographer, to whom are due my warmest acknowledgments for the interest, patience, ingenuity, and skill with which he assisted me.

We worked through the Hydrogen γ line (2796 of Kirchhoff's scale) which, though very faint to the eye, was found to be decidedly superior to F in actinic power. The photographic apparatus employed consisted merely of a wooden tube, about 6 in. long, attached at one end to the eye-piece of the spectroscope, and at the other carrying a light frame. In this frame was placed a small plate-holder, containing for a sensitive-plate an ordinary microscope slide, 3 in. by 1. The image of the prominence seen through the open slit, is magnified and thrown upon this plate by the eye-piece. Fig. 1 shows the instrument with this apparatus attached.

It would be easy to improve this arrangement in many respects, and whenever I resume the subject I propose to do so.

As the equatorial, however, has been dismounted, to be put in order for the observation of the December eclipse, further attempts in this direction must be postponed until next spring.

Observations of the Solar Protuberances

Without prolonging this article with the detail of observations, I add a few of the results which have been obtained since Sept. 10.

About forty different prominences have been more or less carefully observed; sixteen have been sketched. Most of them fall, naturally enough, into the categories established by Zöllner and Lockyer, and are fairly represented by figures already published in the *Journal of the Franklin Institute*.

A few deserve especial mention, however. Fig. 3 represents a small one which was observed upon the E. limb of the sun, on September 14, about 4.30 P.M. From the point marked A, which was very brilliant, a small fragment detached itself and rose towards A′, enlarging in size and growing fainter as it rose. It disappeared (from faintness) in about 12½ minutes, at a distance of 2′ 30″ above the limb of the sun, as determined by the time, 8″·5, which was occupied by the intervening space in passing over the slit of the spectroscope. Allowing for the obliquity of the motion to the parallel of declination, the length of path passed over by this cloud was more than 90,000 miles, and the velocity above 120 miles per second.

Fig. 4 represents a prominence observed September 20, at 4 P.M., on the S.E. limb. (Pos. S., 60° E.) It was a nearly vertical stream, made up of spindle-formed filaments, and had attained the enormous height of 3′ 20″ or 90,000 miles (determined, as in the case above mentioned, by a time-observation, corrected for inclination). It was very brilliant near the base, and at two or three other points along its length. At 4.30 it was nearly gone, only a few faint wisps of cloud remaining.

Another, observed on September 27, at 4.10 P.M., and situated on the W. limb of the sun, is represented in Fig. 5. It was formed of separate, well-defined narrow streamers, which appeared to consist of matter, first violently ejected, and then as violently deflected, by some force acting nearly at right angles. The altitude of the highest point was 1′ 25″, the length of the whole about 3′ 30″. I am unable to see how any mere projection from the sun could have produced such a form, and cannot help feeling that it indicates a something in which powerful currents may exist, even at great elevations above the solar surface; in short, an atmosphere extending far beyond the limits which calculation would seem to assign as possible. Is it wholly unlikely that at such an enormous temperature the law of Mariotte may fail so completely as to destroy the reliability of any computation that assumes it as one of the data?

Upon the next day the prominence still persisted, but its type was wholly changed: it was replaced by one of the mushroom-formed masses which are so common.

Bright Lines

In the spectra of different protuberances, the following bright lines have been observed, the numbers referring to Kirchhoff's scale: C; D_1; D_2; D_3; 1474; 1515; b_1; b_2; b_3; b_4; 1990; 2001; 2031; F; 2581·5; 2796; h—17 in all. On one occasion, September 27, the base of a prominence on the N.W. limb, close to a spot just leaving the limb, exhibited as many as twelve or fifteen short bright lines between E and F, which are not included in the above enumeration, as I had not time to identify them. It is the only instance in which I have seen this phenomenon, more than once described by Mr. Lockyer.

I desire to call special attention to 2581·5, the only one of my list, by the way, which is not given on Mr. Lockyer's. This line, which was conspicuous at the eclipse of 1869, seems to be *always present* in the spectrum of the chromosphere, and shows the form of its upper surface or of a protuberance nearly as well, though of course not so brightly, as the 2796 line. It has no corresponding dark line in the ordinary solar spectrum, and not improbably may be due to the same substance that produces D_3.

The reversal of the sodium and magnesium lines is not at all uncommon. In some instances these lines were so bright that on opening the slit the form of the prominence could be made out through them. This was the case with a small hand-shaped prominence observed on September 27. Comparing the form thus seen through D′ and D_2 with that given by D_3, it appeared that the sodium line was sufficiently developed for observation only along the edge and at one or two bright points in the prominence, most brilliantly neither at its summit nor its base. Fig. 6 represents the appearance (the slit was perpendicular to the sun's limb). The case was similar with the magnesium lines.

Spectrum of Solar Spots

Several spots have been carefully examined at different times; most of them, in their spectra, gave evidence of unusual disturbances; but by far the most interesting phenomena were exhibited by a large group which was first observed near the E. limb on September 19. Changes of wave-length were frequent in its neighbourhood.

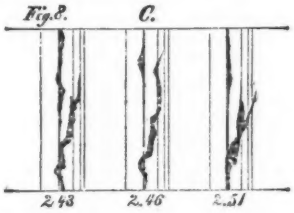
Figs. 7 and 8 represent the appearances assumed by the F and C lines respectively, at the times indicated below each figure, during an observation on the afternoon of September 22. The point where these changes of wave-length occurred was at the western edge of the penumbra. At other times similar changes were observed, but not so great or rapidly varying.

The calcium and titanium lines referred to in my note published in the July number of the *Journal of the Franklin Institute*, were always conspicously thickened in the nucleus spectrum.

The C and F lines were reversed in some portion or other of the group nearly every time I observed it. On September 22 the sodium lines were both reversed for several hours, while D_3 appeared as a dark shade. On September 28, again, at 4 P.M., the southern nucleus of the group (which at this time contained four large umbræ, besides many small ones) reversed all of the following lines, viz.: C; D_1; D_2; D_3; 1474; b^1; b_2; b_3; b_4; F; 2796, and h. All of these were conspicuous, except 1474; D_3 and b_3 especially so, and the latter (a nickel line) showed considerable changes of wave-length, alternate increase and diminution, which were not shared by its magnesian neighbours, b^1, b_2 and b_4.

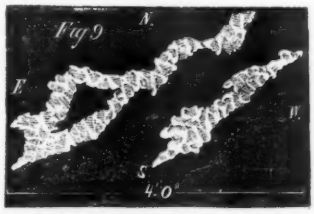
At 4·05 P.M. the brilliance of the F line increased so greatly that it occurred to me to widen the slit, and to my great delight I saw upon the disc of the sun itself a brilliant cloud in all its structure and detail identical with the protuberances around the limb. Indeed, there were *two* of them, and there was no difficulty in tracing out and delineating their form. Fig. 9 represents them as they were from 4·05 to 4·10; Fig. 10 gives the form at 4·15 to 4·20. They were then considerably fainter than at first. During the intervening ten minutes I examined the other lines of the spectrum, and found that the form could be distinctly made out in all the *hydrogen* lines even in h; but that the reversal of the other lines, including D_3, was confined to the region immediately over the spot-nucleus, where the smaller but brighter cloud terminated abruptly; or, I might better say, *originated*. The larger one faded out at both ends. When the clock-w[illegible]

of the equatorial was stopped, the luminous cloud took 16·7 seconds of time to traverse the slit which was placed parallel to the hour-circle. This indicates a length of at least 130,000 miles without allowing anything for the foreshortening resulting from the nearness of the sun's limb.



By five o'clock the clouds had nearly disappeared; a little rack alone remained.

At 4.20 I examined the spot with the equatorial, using the ordinary solar eye-piece. Nothing remarkable was to be seen—not the merest trace of the enormous masses of incandescent gas.



It will be interesting to learn whether the earth responded to this magnificent eruption on the sun by any magnetic storm.

I may add that in the telescope this group of spots, from their first appearance, exhibited a strong yellowish tinge, which appeared to overlie all the central portion of the cluster. So conspicuous was it that several persons, unaccustomed to astronomical observation, noticed it at once before I called their attention to it. The penumbra of the group was unusually faint.

Hanover, N.H., October 3 C. A. YOUNG

NOTES

THE first detachment of the Eclipse Expedition for Spain and Algiers started from Portsmouth in H.M.S. *Urgent* on Tuesday morning; the Sicilian party followed overland yesterday evening. An error crept into the names of the party in our list published last week. Professor Roscoe's assistant is Mr. Edward Ernest Bowen, M.A., late Fellow of Trinity College, Cambridge.

AT one of the most recent sittings of the French Institute a communication was made by M. Faye on the intended departure of M. Janssen to join the Eclipse Expedition. This celebrated astronomer was to leave Paris in a balloon constructed for his private use at the expense of the French Government, and which will also carry a telescope, constructed in eight weeks by the most skilful workmen in Paris, and of the capacity of 2,000 cubic metres. It will be fitted up with a new kind of valve, invented by M. de Fonvielle, and which was not quite ready when that gentleman left Paris. According to every probability M. Janssen will ascend with M. Tournier, one of the passengers in the "Pole Nord," but taking the management of the balloon under his own care. The telescope was put in hand a very few days after the 4th of September. The Government appeared so anxious to show the interest taken in the matter that they did not lose a single day after they came into power in fitting up this expedition. The expenses of the construction of the telescope were incurred by the Bureau des Longitudes.

THE French *Académie des Sciences* has held its sittings regularly since the commencement of the siege, and the *Comptes rendus* has been published regularly every week. Every sitting is reported fully, and several numbers have had even more than the average number of pages. A large part of them is devoted to military science and to ballooning. The scheme put forward by M. Dupuy de l'Ome was fully discussed and illustrated by copper-plates: an article contributed to the *Presse*, by Mr. Giffard, the celebrated engineer, when reporting upon his aërial experiments as much as twenty years ago, has been reprinted. It was shown that Dupuy de l'Ome's experiment was almost of the same nature, and the *Académie des Sciences* has apologised for not publishing it in proper time. M. Dumas and M. Elie de Beaumont, although members of the former senate, now act in their capacity of *sécretaires perpetuels* of the Academy. M. Leverrier has not appeared at any of the sittings. M. Chasles is most punctual in his attendance. Lectures are given at the *Conservatoire des Arts et Métiers*, and are to be given at the *College de France*. No lectures have been given this session at the *Sorbonne*. Since the commencement of the siege, a few numbers only have been issued of the *Révue des Cours Scientifiques*; *Les Mondes* and *Cosmos* have been entirely suspended.

A LARGE number of the animals at the *Jardin des Plantes* and *Jardin d'Acclimatation* have been sold and slaughtered for food, even the bears having now been sacrificed. The trees in the latter garden have been almost entirely cut down either for charcoal or for the necessities of the defence.

WE are very glad to be able to report that Sir Roderick Murchison has gained strength during the past week, though his state still continues critical. Prof. Balfour Stewart will have to remain at Harrow for at least some weeks, but is progressing as satisfactorily as possible, considering the nature of his injuries.

THE ratepayers of Marylebone have done good service to Science in electing Miss Garrett, M.D., and Prof. Huxley to the London School Board, first and second on the poll, the former by a triumphant majority over every other candidate. If their example is generally followed throughout the country, we may anticipate great things in the future for the scientific education of the country.

OWING to Professor Tyndall's absence with the Eclipse Expedition, the first conversazione at the London Institution, announced for Dec. 21st, is postponed till Jan. 25th, when he will deliver his lecture on Dust and Disease.

WE regret to learn that the North London Naturalists' Society terminated its existence on Monday, Nov. 27. It has been established for about six years, and was for some time carried on with spirit; but the interest in it has for some time been on the decline, and it was considered advisable to bring it to a close. We understand that it is in contemplation to form another society in its place, which only actual workers will be invited to join. When we consider how many useful bodies of this description are scattered throughout the country, it seems strange that a similar one cannot be kept afloat in London; but the fate of the North London Club, preceded as it was by the collapse of the Society of Amateur Botanists, and of the West End Naturalists'

Society, is somewhat discouraging, and a well-supported body of workers in all branches of Natural Science seems likely to be a desideratum.

PROF. HASSKARL reports that the cultivation of Cinchona in Java is proceeding satisfactorily. The weather, on the whole, has been favourable, and the growth of the plants leaves nothing to be desired. The number of plants grown from seeds and layers is upwards of one and a half millions, by far the greater number belonging to the species *C. calisaya*, a good many to *C. officinalis* and *succirubra*, and a very few to *C. lancifolia* and *micrantha*. In addition to these, 870,000 plants have been transplanted, and the whole shows an increase of nearly 200,000 plants since the commencement of the year. 460 kilogrammes of the dry bark were sent to Holland in December, 1869, and sold at from two to three florins per kil. ; 900 kilogrammes have since been exported, and more than 1,000 were ready at the date of the despatch. Prof. Hasskarl reckons the total produce of 1870 at no less than 4,000 kilogrammes of dry bark for exportation, besides some hundreds for home use in the island. An important branch of industry in the colony is now formed by the stripping, cutting, drying, sorting, and packing of the Cinchona.

THE report of the Hartley Institution, Southampton, for the current year gives a very favourable account of its position and prospects. The students in the day classes have increased from twenty-nine last year to eighty-six ; in the evening classes there have been thirty-one. Among the students of the engineering department there have been as many as eighteen government nominees to the Telegraphic Service of India, who have been pursuing an advanced course of instruction in mathematics and physical science to qualify them for their final examination. A class of fourteen nominees has also been under instruction in the Institution during the year in practical telegraphy. At the last final examination for appointments to the Indian Telegraphic Service, all the successful candidates, except one, had been instructed in the Institution. There is a library of 400 or 500 volumes in connection with the Institution, a reading-room amply supplied with the current literary, scientific, and political publications of the day, and a good course of lectures was delivered during last session.

A WRITER in the *Boston Post* of October 24 thus describes the present condition of the Museum of Comparative Zoology in that city :—Since the acquisition of the private collection of Prof. Agassiz, the Boston Museum may claim to rank among the foremost institutions of its kind ; for although the British Museum in London and the Jardin des Plantes in Paris are on a very much larger scale, yet in certain departments, such as corals and fishes, the Museum of Comparative Zoology is superior to both, while the increase of its collections since its existence, and the prominence it has attained among other museums, are such as no like establishment has reached in the same time and with the same means. From want of room the greater part of the Museum as it now exists is occupied by working-rooms and store-rooms, and only four rooms are devoted to exhibition. Each of these contains the representatives of one great division of the animal kingdom, and it is intended to complete them in such a manner that they shall exhibit in an easy and conspicuous way the natural relations of all the animals known in creation. In the new building now going up, which adjoins the present Museum and is to be of equal dimensions, it is intended to exhibit all the animals peculiar to the different parts of the world, in such a manner as to impress the observer with their natural association in nature, so that the student of Natural History shall be able to make himself familiar in one part of the building with the latest result of scientific research in working out the system which binds together the whole animal kingdom as a unit ; while in the other part of the building their geographical distribution upon the whole surface of the earth, and their various combinations and associations on different continents will be made apparent. Such a twofold arrangement of collections has never yet been attempted in any museum, not even in the largest and most prominent institutions of the kind in Europe. The fossil remains of past ages will be exhibited in like manner in such an arrangement as to display at the same time their order of succession in geological periods, and their relations to the animals now living. It is intended to complete this plan by exhibiting also the different stages of all known animals, from their earliest period of development in the egg to their adult condition. This is a truly magnificent plan, but although the addition to the Museum will double the amount of room, yet the whole of this plan cannot be carried out at present, and a large part of the collections must still remain in the store-rooms until another section of the building can be completed. It is sincerely to be hoped that the strong interest which has already been shown by the Legislature of Massachusetts and the citizens of Boston will not flag, and that sufficient aid will be given to carry out and fully complete this admirable work, within the lifetime of the distinguished man who has done so much to elevate the tone of thought, and improve the method of education in this his adopted country.—We imagine it must be only typical animals of each group that are referred to in the above account. It is to the munificence of a private patron of this Museum, Mr. Nathaniel Thayer, that Science is indebted for Prof. Agassiz's recent exploration of Brazil, with six trained assistants.

A SECOND paper on "Mystic Trees and Flowers" appears in *Fraser's Magazine* for this month. Herbaceous plants form the subject of this portion, the mandrake (of the history of which an especially interesting sketch is given), mistletoe, rose, lily, violet, and primrose, being the principal which are touched upon in detail. The author, Mr. Moncure D. Conway, in some concluding remarks, states his belief that "the reverence paid to trees and flowers" must be looked upon "not as fetish worship, but as a sacred regard paid to them as oracles of beings higher than themselves," and combats the idea "that it was from these lower objects that reverence gradually ascended to the adoration of the sun and stars, as the case was really the reverse."

THE *British Medical Journal* quotes the following description of "The Nemesis of Tobacco," from the ninetieth observation of Theodorus Kerckringius, M.D. (*Spicilegium Anatomicum*, Amsterdam, *circa* 1670) describing the *post mortem* appearances of an inveterate smoker :—"Too greatly, now, alas ! in Europe, prevails that *cacoëthes* of sucking up the smoke of the herb tobacco, as they call it, through tubes actually manufactured for that special purpose ! In consequence, what a perversity of morals has arisen they must have noted whose duty it is to attend to the public morality, whether they be politicians or theologians. How noxious it is to the health of those who indulge in the habit of sacrificing so often to Vulcan, or rather to Charon, I shall not here explain. Let it suffice, that I adduce the case of a man whose body I opened before the Faculty. He, ordinately given to these fuliginous delights, had scarcely ever engaged in any kind of work, as it appeared, without inhaling this fatal juice. When, however, at length, Nature, assailed by frequent attacks, began to fail, and to give way to disease, he rejected for so long a time a black-looking matter, both upwards and downwards (*per utrumque gutturem*) that at last he vomited forth his dusky soul ; which to accompany in its visit to the realms of Pluto would be far from agreeable, for, I suspect, it would greatly, and that from habit, have preferred those black lakes, steaming with the bubbles of Stygian vapours, to the lucid stars of heaven, inasmuch as it had long been fed, though not

nourished, by smoke; the abode, however, it had relinquished, I visited and examined by the aid of the scalpel of the anatomist. What did I observe, you ask? It appeared to me that I was passing into the very house of Pluto himself; even the entrance-doors were tinged of a black colour, and the tongue, imbued, as it were, with the poisonous juice, was in a state of tumefaction. What as to the windpipe? It was like the inside of a chimney, coated completely with black grime. The lungs were dry, sapless, and scarcely at all friable. The liver, as if it, beyond all the other organs, had attracted the fire, was altogether inflamed; from the flames of this fire not even the bile in its receptacle had been safe, for its colour had changed from purple to green (*ex purpureo virescentem*). In the intestines, however, the drains of the body, the carbonaceous matters from the whole combustion had become concentred, for they were full of a black substance which exhaled no milder stench than that of Hell itself. Such, of this frequent suction, are the medicinal fruits!"

AT the meeting of the Geologists' Association, on Friday evening last, Mr. R. Etheridge read a paper on "The British Islands Past and Present, Physically considered." After making some remarks on the intense interest and importance of the subject, he proceeded to describe the distributi n of land and water at different geological epochs, and to show that England, Ireland, and the Continent, were once united, and that the many and great changes which have taken place have arisen from the elevation or depression of the land, not from alteration of the sea level. Mr. Etheridge then referred to the changes which have taken place in the relative positions of land and water during the historic period, giving instances of towns and cities that in the time of their prosperity stood some distance from the sea, but have been gradually submerged, and other places, whose importance arose from their contiguity to the ocean, now left high and dry inland. The paper was illustrated by a splendid collection of diagrams.

THE Seventh Annual Report of the Belfast Naturalists' Club shows that this useful Society is making good progress. By the kindness of the Council of the Natural History Society, members of the Club have been permitted to re-arrange the valuable local collections in the Museum; and a large sum has been granted by the Council for cases, &c., in which to exhibit a complete local collection. The local land, freshwater, and marine shells have been named and arranged; the Herbarium is in progress; and the Geological collection selected and named, ready for mounting. The Committee have also considered it desirable that the Club should prepare complete lists of the fauna, flora, geology, and archæology of Ulster, by publishing an annual contribution to such a work in addition to the ordinary report. The Appendix in the present issue consists of a list of the Irish Liassic Fossils, with notes on new and critical species, by Ralph Tate, Esq., F.G.S. The number of species enumerated is 189; of which the following are new to science:—*Chemnitzia punctata*, *Solarium thompsoni*, *Tornatella robinsoni*, *Pleurotomaria tectaria*, *Hinnites angularis*, *Avicula pattersoni*, *Leda v-scripta*, *L. quenstedti*, *Cucullæa gryingeri*, *Mytilus subtulis Thracia æquata*, *Anatina myacina*, *Pollicipes alatus*. Figures of many of these are given in an accompanying plate, and the paper is a valuable contribution to local geology. We congratulate the Belfast Club on having successfully started a work which will give a permanent value to their annual reports, and trust that their example will be widely followed by other local societies.

IN the Chittagong district the Government of India has discontinued explorations for coal at present, as the samples found are of an inferior and unpromising quality.

BALLOON ASCENTS FOR MILITARY PURPOSES

AS soon as the war broke out, balloons, which had been so long forgotten by statesmen, were recalled to their memory by hundreds of projectors. Some of the schemes suggested were of the wildest description; and scientific men took advantage of this circumstance to reject everything connected with aëronautics. But surprises and reverses became so frequent in the French army, that it became evident that any apparatus able to carry observers would be considered as a preserver from such disgraces. As soon as it was clear that the Prussians were intending to besiege Paris, the Minister of War issued orders for the construction of a captive balloon, intended to watch the movements of any besieging army moving round the capital; but instead of having recourse to Mr. Giffard, the constructor of so many magnificent balloons, it was resolved to employ MM. Godard and Nadar. Paris was divided into aërial districts, the first being given to Nadar and the other to Godard. Nadar then received orders to establish his balloon on the foot of Buttes Montmartre, and Godard close to the Montsouris Meteorological Observatory on the banks of the small streamlet Bièvre, where it crosses the fortifications. The balloons intended to be attached were not made on purpose, they merely used old ones which were worn out; the gas-pipes were also not sufficiently large, and the gas-pressure was very low, so that when the first attempts at inflating were made, the Godard balloon took more than three days to be filled; and, when filled, was tossed so heavily by the wind, that it was necessary to let the gas escape. Nadar was still more unfortunate, and could not arrive even at the inflating of his balloon, except after immense labour, by laying a pipe along the ground for a space of more than 300 yards. Moreover, when the first balloon was floated, it was as late as the 4th of September. I then ordered Godard to continue his inflating process. Many scientific bodies met, and deliberated upon the modes of improving captive balloon ascents; but none of the members had ever ascended, and hence their practical knowledge was so small as to amount practically to nothing.

I tried to improve in some respects the construction of captive balloons, by using the process of fixing to the rope invented and practised by the aëronauts of the First Republic, and offered to the State a balloon, which had been given to me by my friend, Mr. Giffard, and which had, unfortunately, only a capacity of 28,000 cubic feet. I had already used this balloon for an ascent, executed for the benefit of the Arène de la Rue Monge.

That balloon was fitted up in a more scientific manner, the appendix being also firmly attached with rope, so that the pressure of the wind could not let a single puff of gas escape. The equatorial ropes were attached together and connected by means of little pulleys, the pulleys being connected by ropes, and so on till the whole of the network ended in three large ropes. This machinery worked admirably well, but the material of the balloon was not fit for the purpose. After two or three weeks' standing, the company was dissolved, and the balloon was sent free into the air. Captive observations were not so useful as had been hoped; that partial failure was owing to the unfitness of officers entrusted with the duty of making observations, and of the men employed in the drawing of the ropes. Nothing of the kind would have happened if Government had accepted the offers made by Mr. Giffard before the beginning of the war. That great engineer had offered to spend 40,000*l.* in the construction of a large balloon of 15,000 cubic metres capacity, able to carry 40 persons to the height of a full kilometre, but the Government had refused this proposal because Mr. Giffard asked for a place in the Champs Elysées, where it would have been necessary to displace a few shrubs.

When the investment of Paris was completed, the question naturally arose of using balloons for carrying messages, the resolution having been taken by the minister, M. Rampont, Post-office Director, to summon to his office several aëronauts, Nadar, Artoise, myself, and a few gentlemen supposed to be acquainted with aërostatics; and the ascent was decided upon in a long discussion.

The first who ascended, was Durioff with his own balloon, famous from several ascents. Durioff started up into the air early in the morning, and employed an immense lifting power, the wind blowing strongly besides, and Durioff disappeared like a dream. He was alone in his car, carrying a bag of letters, with plenty of ballast; I protested in the most urgent manner against sending into the air a single man unassisted, but without any success. The advice was neglected in consequence of the success of the

first operations. Reverses were necessary to call postal authority to a better sense of the real state of things. M. Garnier Pagès, a member of the new Government, invented the carrying by balloons of aërial pigeons, and the second balloon ascent was the occasion of the first pigeon expedition.

One of the aëronauts known to our readers is Mangin, the proprietor of the unfortunate "Union," of which the wreck was fully described, who tried an ascent a few days after Durioff. He made a foolish agreement with the Post Office, to carry with his poor worn-out balloon a weight of 1,000lbs., but the balloon was unable to retain a single puff of gas, and the attempt was doomed to failure.

Two or three days afterwards, Mangin tried another ascent with the "City of Florence," a large balloon of 1,200lbs. capacity and belonging to Eugène Godard.

The "City of Florence" was inflated and fitted up by its proprietor, and left the ground on the morning of a clear day, with a light north-easterly wind. It carried with Mangin a medical man practising at Lyons, with a special mission from the Government for the eastern departments. The ascent succeeded very well, and Dr. Lutz was landed safely. But the landing of Lutz gave rise to a singular circumstance. A Prussian spy, having read in the papers that Lutz had come down from the heavens, presented himself at Dijon as the real Lutz, and acted in accordance with that suggestion. The fraud was not discovered without some delay and some trouble, but owing to some peculiar circumstances it was at last exposed, the false Lutz was seized, tried by a court-martial, condemned to death, and shot on the spot.

Amongst singular ascents one was executed two or three days afterwards by Louis Godard, carrying with him two merchants. Godard's balloon being too small for the purpose, he fixed one additional balloon to the end of a long narrow piece of wood, and in the middle of that long singular bridge there was a second balloon of no more than 100 cubic metres. The floating of this extraordinary trio created a great deal of amusement among our Belgian people, and is in itself an aërial aëronautical success; Godard landed near Nantes, where the Prussians had not yet set their feet.

Next to Godard's singular ascent, we must mention the one executed by Trignot for carrying Gambetta to his post at the head of the Government. An accident took place in the air while it was open, and the balloon emptied itself at an extraordinary rate, landing, against the will of the aëronauts, in Prussian territory. If sharpshooters had not come to the rescue, Gambetta would have been made a prisoner. Kératry was in the same manner sent in a balloon, and succeeded in escaping after some adventurous feats.

We must mention the ascent conducted by the elder Tissandier, as well as the one conducted by his younger brother. The first of these two ascents was remarkable for the firing at it by the Prussians when the balloon was passing over Versailles. Tissandier, as well as his brother, fell beyond Prussian territory, but not far from the enemy's force.

From the time of the landing up to the present moment, the brothers Tissandier have tried twice to return to Paris; but they ascended from Tours, which is a bad station for such a purpose. The first time their balloon was sent towards the south; the second time it ascended too high, and the brothers were conducted into a frozen cloud, which compelled them to come down. This second ascent was tried during the night, which is a decidedly awkward time, as an aërial traveller is unable to find his way to the land.

Returning to Paris will be tried, however, and is a great object to be attained, but for success to be secured requires more powerful means. I must not omit my own arrival in Belgium in a balloon. The "Egalité," which I employed on that occasion, had a younger brother called "Liberté." The "Liberté" was inflated with pure hydrogen, prepared specially for the purpose. It was the old captive of the Universal Exhibition, fitted up and carefully repaired for the purpose. "Liberté" was intended to carry ten persons, besides 3,000lb. weight of letters. It had two cars attached, the one fastened to the other by eight ropes. The upper car was intended for passengers, the lower one for letter-bags. Everything had been carefully prepared; bags of sand had been attached round the upper car, and a hole had been cut into the bottom to permit communication between the two cars. Unhappily, when the process of inflation was half finished, the wind began to blow with such violence that people holding the net let the ropes loose with so much force that the balloon escaped, turned round like a whirlwind, being lost in a minute in the clouds, and leaving thousands of spectators in consternation. "Liberté" was seen turning round two or three times again between different strata of clouds, and was finally observed turning no more, ascending no more, but falling straight like a meteoric stone. The fall took place within the Prussian lines, and it remained in the hands of the Prussians, who were enabled to repair and to use it for their purposes.

Seeing that I was unable to recover my balloon, I managed to get another constructed. The new balloon, though smaller than "Liberté," was larger than any other balloon in existence in Paris. It had a measurement of 3,000 tons instead of 2,000, the average. The ascent was delayed by an accident which happened during the process of inflating; a hole was discovered round the appendix, and the valve was open. For the three following days the weather was unfavourable, and the passengers were obliged to come back every morning, but the following morning several thousand people witnessed the ascent, which was very successful. After having landed in Belgium, I came to London on my way to Tours, and purpose shortly attempting to re-enter Paris by the same means.

W. DE FONVIELLE

SCIENTIFIC SERIALS

Annalen der Chemie und Pharmacie, viii. Suppt. Bd. 1 Heft. This number opens with a paper "On the occurrence of Ammonio-Magnesic Sulphate in the lagoons of Tuscany," by Dr. O. Popp, who has observed that a double salt of ammonic and magnesic sulphates is of constant occurrence, together with ammonic sulphate and boric acid, in the lagoons. He also remarked that the relative amounts of boric acid and ammonic sulphates are inversely proportional, so that those containing large quantities of boric acid contain but little ammonic sulphate, and *vice versa*. The salt, which separates out either during the concentration of the water or in the crystallising vessels, is obtained pure by recrystallisation in forms belonging to the monoclinic system, and of the composition

$$Mg\,SO_4 + (NH_4)_2\,SO_4 + 6\,O\,H_2.$$

In the natural double sulphate Mg is often replaced by the isomorphous Mn and Fe. — "On the origin of the Boric Acid in the Fiumaroles of Tuscany" is by the same author. After a criticism of the theories of Dumas and Bolley on this subject, he quotes the observations of Woehler and St. Claire-Deville, that boric nitride heated in the presence of aqueous vapour is decomposed into boric acid and ammonia, and that at a high temperature boron and nitrogen combine directly; they remarked that the presence of ammonia salts together with boric acid in volcanic craters and the lagoons of Tuscany might be due to such a decomposition. This the author also considers to be the probable explanation, and assumes that boric nitride is present in these volcanic localities, which comes in contact with water at a high temperature, forming boric acid and ammonia; this latter combines with sulphuric acid, formed by a process of roasting from the layers of pyrites, or of coal containing pyrites, which would also account for the presence of marsh gas and free hydrogen in the lagoon gases.—"On Chloranil and Bromanil," by J. Stenhouse. A modification of Grœbe's method of preparing chloranilic acid is described. Chloranilic ether was obtained by the action of ethylic iodide on the silver salt. Nitric acid of sp. gr. 1·45 oxidises chloranilic acid to chlorpicrin and oxalic acid. By the action of bromine on chloranilic acid a compound of the formula $C_6\,Br_3\,Cl_3\,OH$ was obtained. Bromanil is readily obtained by the action of a mixture of one part iodine and two parts bromine on phenol. Bromanilic acid was prepared in a similar manner to chloranilic, and in all its reactions found to be analogous. A compound, $C_6\,Br_{11}\,O\,H$, was obtained by the action of bromine on it.—"On Coumarin, Hydrocoumarin, and Hydrocoumarinic Acid," by C. Zwenger. The author observes that the preparation of coumaric acid from coumarin is attended with considerable difficulty, inasmuch as the acid is first formed at a temperature at which the potash readily causes a further decomposition. A most characteristic and delicate reaction for coumaric acid is the fine pea-green colour of its solutions when viewed by reflected light, and which is perceptible when only traces even of the acid are present. As is well known, melilotic acid is obtained by the action of nascent hydrogen *in excess* on coumarin; the author finds, however, that if the coumarin be kept in excess a new acid, which he calls hydrocumarinic, is formed. This acid is derived

by the addition of H_2 to two molecules of coumarin, and has the composition $C_{18}\ H_{18}\ O_6$. On heating in a water bath, or even on heating with dilute HCl or H_2SO_4, it loses water and is converted into the anhydride $C_{18}\ H_{14}\ O_4$, which may also be obtained directly from coumarin.—"A New Method of Synthesis of the Organic Acids," by M. Berthelot. On allowing acetylene mixed with air to remain in contact with dilute potash solution for six months, the acetylene was found to have been converted partly into acetic acid and partly into a bituminous substance, containing C H and O. Employing a solution of chromic anhydride, a more perfect conversion of the acetylene to acetic acid took place. Allylene treated in the same way gave propionic acid; but it is probable that an intermediate compound $C_3\ H_4\ O$ is formed by the direct addition of O, and which should also be obtained by the abstraction of OH_2 from propionic acid. Propylene gave propionic acid, acetone, and acetic acid; even carbon was oxidised by this reagent, giving small quantities of oxalic acid. It deserves notice that a solution of pure chromic anhydride is a much gentler oxidising agent than the usually employed mixture of sulphuric acid and potassic dichromate, probably partly by reason of its evolving a smaller proportion of oxygen. By its decomposition, free oxygen and chromic chromate, a salt corresponding to ferric sulphate, are formed:

$$5\ Cr\ O_3 = Cr_2\ O_6\ 3\ Cr\ O_3 + O_3$$

"On the synthesis of aromatic acids, by A. Wurtz." By the action of $Na_2\ Hg$ on a mixture of chlorocarbonic ether and bromtoluol, the ethers of toluylic and isotoluylic acids were formed, which is explained by the fact that bromtoluol is a mixture of two isomeric compounds. On treating a mixture of chlorocarbonic ether and benzylic chloride, the following more complicated reaction takes place:

$$2\ C_7\ H_7\ Cl + CO\ Cl\ OC_2\ H_5 + 3\ Na = 3\ Na\ Cl + H + C_{14}\ H_{13}\ CO\ OC_2\ H_5$$

(Dibenzylcarbonic ether.)

The first action of the sodium is probably to form chlorinated dibenzyl,

$$\left\{\begin{matrix} CH_2\ C_6\ H_5 \\ CH\ Cl\ C_6\ H_5 \end{matrix}\right.$$

from 2 mols. of benzylic chloride, and this by the action of Na and $CO\ Cl\ OC_2\ H_5$, becomes converted into

$$\left\{\begin{matrix} C\ H_2\ C_6\ H_5 \\ C\ H\ CO\ OC_2\ H_5\ C_6\ H_5 \end{matrix}\right.$$

By the dry distillation of its lime salt, stilben and dibenzyl are obtained:

$$2\ (C_{15}\ H_{13}\ O_2)\ Ca = Ca\ CO_3 + CO + C_{14}\ H_{12} + C_{14}\ H_{14}$$

—"On the molecular weight of some Protoxides," by A. Ladenburg. This is really so important and interesting a paper that it is difficult to give an idea of its contents in the short space at our command. Although the determination of the vapour density is still the most certain method of establishing the molecular volume, it cannot be denied that the true interpretation of chemical metamorphoses also affords a means of fixing the molecular formulæ of compounds. The author also considers this to be the case in those reactions which cause a change of type, viz., in cases of direct addition. The molecular volume of the resulting product permits in many cases at least an inference as to the formula of the unsaturated compound. For instance, from the passage of ferrous into ferric chloride, he believes himself justified in drawing the conclusion that $Fe_2\ Cl_4$ is the formula of the former, $Fe_2\ Cl_6$ being that of the latter, as is proved by its vapour density. The same may be urged of Cr and Mn compounds, although not with the same certainty, and it was to obtain further proofs in this direction that the author strove. By the action of a mixture of 3 eq. acetic and 1 eq. formic acid on manganous carbonate, a compound $Mn_2\ (C_2\ H_3\ O_2)_3\ C\ H\ O_2$ was obtained, but it is not placed beyond all doubt that this is not a mixture of two salts. A series of experiments with tin compounds were then undertaken with the view to ascertain whether the compound $Sn_2\ Cl_6$, intermediate between $Sn\ Cl_2$ and $Sn\ Cl_4$ could not be obtained. By the action of Br on $Sn\ Cl_2$, $Sn\ Cl_2\ Br_2$, $Sn\ Cl_3\ Br$, and $Sn\ Br_3\ Cl$ were formed, revealing the curious fact that similar molecules so react on one another that dissimilar molecules result:

$$Sn\ Cl_2\ Br_2 + Sn\ Cl_2\ Br_2 = Sn\ Cl\ Br_3 + Sn\ Br\ Cl_3.$$

No experimental proof of stannic triethide being $Sn_2\ (C_2\ H_5)_6$ and not $Sn\ (C_2\ H_5)_3$ had hitherto been adduced; it was prepared by the action of Na on $Sn\ (C_2\ H_5)_3\ I$, and its vapour density determined and found to agree with that required by $Sn_2\ (C_2\ H_5)_6$. The action of Cl on stannic triethide is as follows: $Sn_2\ (C_2\ H_5)_6 + Cl_6 = 2\ Sn\ (C_2\ H_5)_2\ Cl_2 + 2\ C_2\ H_5\ Cl$. By the action of I first $Sn\ (C_2\ H_5)_3\ I$, and then $Sn\ (C_2\ H_5)_2\ I_2$ is formed. By the action of sodic ethylate on $Sn\ (C_2\ H_5)_3\ I$ stannic ethylotriethide $Sn\ O\ C_2\ H_5\ (C_2\ H_5)_3$ was obtained. There then follow a number of similar experiments on stannic methides, &c.—"On Schiel's chloraluric acid," by N. Lubavin. Schiel described an acid obtained by the action of chlorous acid on uric acid, to which he gave the formula $C_{14}\ H_{11}\ N_8\ Cl\ O_{11}$ (old atomic weights); this Lubavin proves to be a mixture of ammonic chloride and parabanic acid. He also mentions an oxalate of urea of the composition $CO\ N_2\ H_4, C_2\ H_2\ O_4 + O\ H_2$ the formula of the ordinary oxalate being $2\ C\ O\ N_2\ H_4, C_2\ H_2\ O_4$. In all the text-books 120° is given as the fusing point of urea; he finds it to be 132°.—"On derivatives of Anethol," by A. Ladenburg. On fusing anethol (oil of anise) with caustic potash, the following reaction takes place:—

$$C_6\ H_4 \left\{\begin{matrix} O\ C\ H_3 \\ C_3\ H_5 \end{matrix}\right. + K\ O\ H = C_6\ H_4 \left\{\begin{matrix} O\ H \\ C_3\ H_5 \end{matrix}\right. + C\ H_4\ O$$

Treated with $P\ Cl_5$ H becomes replaced by Cl

$$C_6\ H_4 \left\{\begin{matrix} OCH_3 \\ C_3\ H_5 \end{matrix}\right. + P\ Cl_5 = C_6\ H_4 \left\{\begin{matrix} O\ C\ H_3 \\ C_3\ H_4\ Cl \end{matrix}\right. + HCl + PCl_3$$

This body treated with alcoholic potash loses H Cl and gives $C_{10}\ H_{10}\ O$, a liquid boiling at 240°. All experiments to replace the Cl in chloranethol by $C_2H_3O_2$ failed. Anethol combines directly with Br_2.—"Researches on Vanadium," by Henry E. Roscoe. In this communication are described vanadic tribromide and oxytribromide; also a large number of meta, ortho and pyrovanadates, among others the artificially prepared vanadinite. As this paper appeared in English in the Chemical Society's Journal, it has already been noticed in this journal.—"On the second fundamental theorem of the mechanical theory of heat and its application to several decompositions," by Dr. A. Horstmann. The author has given a popular treatment of the mechanical theory of heat, as he considers that although of the greatest interest to chemists, it has remained comparatively unknown to them by reason of its requiring a somewhat high mathematical knowledge. The decompositions to which it is applied are those of ammonic chloride and calcic carbonate by heat, and also the expulsion of the water of crystallisation from hydric disodic phosphate.

SOCIETIES AND ACADEMIES

LONDON

Geological Society, November 23.—Mr. Joseph Prestwich, F.R.S., president, in the chair.—1. "On some points of South-African Geology." Part 1.—By Mr. G. W. Stow. In this paper, which was illustrated by numerous sketches, sections, tables, and specimens, observations were made on the stratification of the Jurassic beds of Sunday's and Zwarktop's rivers, resulting from researches made by Mr. Stow, with the view of determining the exact position of the several species of fossils found at the exposures on the cliffs of these rivers, and from this the sequence of the various beds. He indicated the existence of at least nine separate fossiliferous bands, pointing out the relative positions of the several *Trigonia*-beds, Hamite-beds, Ammonite-beds, &c. He next treated of the so-called Saliferous beds of the district, and gives his reasons for regarding them as later in age than the *Trigonia*-sandstones above alluded to, and therefore not equivalent to that part of the series named "Wood-beds" by Dr. Atherstone. Other researches of the author related to the Tertiary beds both inland and on the coast. He distinguished three zones on the coast later in date than the high-level shell limestones (Pliocene?) of the Grass Ridge and other parts of the interior. One of the coast-zones he named the *Akera*-bed, from the prevalence of a delicate species of that genus. Another zone was described as following the river-valleys in the form of raised terraces, characterised by the presence of a large *Panopæa*. The latest shell-banks have been thought to be kitchen-middens, but the author regarded them as shore-deposits in place. The author concluded by tracing the probable climatal and geographical changes in this region during geological times, and indicated, as far as his material allowed, the probable migrations of the Mollusca, especially of the *Venericardia* characterising the Pliocene Limestone. Mr. Gwyn Jeffreys remarked that all the shells belonging to the genus *Akera* which he had examined were shallow water or littoral shells. Dr. Duncan remarked on one of the corals as being of a well-known Crag form, the *Balanophyllia calyculus*. Mr. Searles Wood, jun., observed that there appeared some probability on the face of the paper of the shells of the older post-tertiary beds denoting a warmer climate than the present, instead of, as here, a colder.—

2. "Note on some Reptilian Fossils from Gozo." By Mr. J. W. Hulke, F.R.S., F.G.S. The author described the remains of two reptiles said to have been brought from Gozo by the late Captain Strickland. One of them was a fragment of the symphysial part of the slender mandible of an *Ichthyosaurus*, having teeth of precisely the same character as those of the form from the Kimmeridge Clay described by the author under the name of *Enthekiodon*. For this species the name of *Ichthyosaurus gaudensis* was proposed. The other was the skull of a species of crocodile, for which the author proposed the name *C. gaudensis*. Dr. Duncan suggested that the Ichthyosaurian fossil might be derivative from some secondary rock. He mentioned that Dr. Leith Adams had once sent him an *Aspidiscus cristatus* from the Hippurite Limestone, which was stated to have come from Malta. To account for this, he suggested that the Miocene of Malta might have been supported on beds of Cretaceous age, so fossils from that source might have become indebted in the coral reefs of the later date. Capt. Spratt expressed a doubt of the fossils having really come from Gozo. He did not recognise the cretaceous-looking matrix among any of the rocks of that island, with all of which he was acquainted. The nearest approach to that kind of rock was to be found in the lowest of the deposits near Cairo, which were probably Eocene. Prof. T. Rupert Jones suggested an examination of the Foraminifera in the matrix, with the view of determining its Secondary or Tertiary age. He mentioned the occurrence of rolled nodules of older rocks in beds of later age at Gozo. Mr. Busk stated that a stone of similar character to the matrix occurred in Malta, if not in Gozo, but probably in both. Mr. Hulke, in reply, observed that he had in this paper intentionally left the stratigraphical part of the question untouched, and confined himself to the palæontological aspect of the remains.—3. "On the discovery of a 'Bone-bed' in the lowest of the 'Lynton Grey Beds,' North Devon." By F. Royston Fairbank, M.D. In this paper the author called attention to the occurrence of a thin bed of rock to the west of the harbour of Lynmouth, containing an immense number of fragments of bone, some of them of large size, and associated with massive bodies which he regards as coprolites. The author proposed to call this the "Lynton Bone-bed;" and he thought that its discovery might throw some light on the relative age of the whole series of rocks of North Devon. Mr. Whitaker had examined the beds in company with Mr. Wetherell. He did not agree with the author as to the amount of iron in the beds. The bone-remains appeared to him to be those of *Steganodictyum*, which had already been found in the lowest of Devonian beds. He was not prepared to accept the nodules described as being undoubtedly coprolites. Mr. Valpy stated that there were at least a dozen beds on different horizons of much the same character as that described along the coast of North Devon, an account of which had already been published at Ilfracombe.

London Institution, November 24.—Mr. H. W. Field, F.C.S., in the chair. Prof. Morris, F.G.S., delivered a lecture "On the Precious Metals and their Distribution." Having indicated the principal sources of the gold and silver worked by the ancient nations, he explained the distinguishing characters of these two metals, and dwelt at length on their mode of occurrence, geographical distribution, and geological position. Gold usually occurred in nature in the metallic condition, nearly pure or alloyed with certain metals, while silver was found in combination with various elements, and but rarely in the native state. The distribution of gold throughout the world was illustrated by a large map, on which the known gold-yielding localities were plainly marked. Gold was found in rocks, quartz veins, and alluvial deposits. The silurian rocks and the granites associated with them furnished the chief supplies, but the cretaceo-oolitic rocks of Peru, Bolivia, and California, when traversed by dioritic igneous rocks, were also auriferous; showing, according to Mr. David Forbes, that there had been two well-marked epochs of gold intrusion. From both formations, but specially from the silurian, the gold occurring in alluvial deposits had been derived by the enormous erosion which the rocks had undergone at a comparatively late geological period, namely, the Newer Pliocene. The remains of extinct mammalia discovered in the deposits of the Urals, and also in those of Australia, had satisfactorily fixed their geological position. In Australia and California subsequent volcanic flows had covered thick accumulations of auriferous gravels, and had diverted the courses of many streams, so that they no longer conformed to the old valleys. The minerals mistaken for gold were enumerated and their distinguishing chemical and physical characters were indicated. In conclusion, the lecturer alluded to certain points relating to the use of gold in coinage, and called special attention to the brittleness produced by the presence of minute quantities of palladium in the standard alloy. The lecture was illustrated by numerous diagrams and maps, models of famous nuggets, gold-washing apparatus, and many beautiful specimens of native gold.—Dr. Odling's educational lectures "On Chemical Action," delivered on Mondays at four o'clock, continue to attract crowded audiences, comprising a large number of boys and girls from the schools of London and its suburbs.

Linnean Society, December 1.—Mr. Bentham, president, in the chair.—"On the Source of Radix Galangæ minoris of Pharmacologists." The source of the Greater Galangal has long been known to be *Alpinia galanga*, Linn.; that of the Lesser Galangal has been more obscure. Galangal is not used in English medical practice, and on the Continent has become almost obsolete; its export from China is, however, considerable, and is rapidly increasing. During an expedition to the Island of Hainan, a quantity of the root which provides the Lesser Galangal was observed exposed to the sun in baskets. On a subsequent occasion the plant itself was discovered at a spot six miles inland, at an elevation of 100 feet above the sea, growing in a dry red soil, the result of volcanic action. Here it was evidently planted, but was subsequently detected growing wild in jungles in the same island. Twenty or thirty stalks spring from each root, but rarely more than one or two bear flowers. The fruit appears to be the bitter kind of Cardamom figured by Mr. Hanbury. The plant is closely allied to *Alpinia calcarata*, which flowers readily in the Calcutta Botanic Gardens; but was determined by Dr. Hance to be a perfectly distinct and well-defined species, to which he gave the name *Alpinia officinarum*. A diagnosis of the plant was also given by Dr. Hance.—Supplementary note on the Chinese Silkworm Oaks, by Dr. Hance.

MONTREAL

Natural History Society, October 31.—The President, Principal Dawson, in the chair. Mr. A. S. Ritchie read a paper entitled "Aquaria Studies," Part 2. In a previous paper the author had described the habits of some of the larger inhabitants of his aquarium. In the present sketch an attempt was made to illustrate the peculiarities of the microscopic denizens of the same. The structure of some of the lowest forms of vegetable life was first illustrated, and some points in their physiology described. The first example of the animal kingdom selected was the Amœba or Proteus. In this animal we see a creature devoid of muscular or nervous system, with no head, no stomach, or alimentary canal. Its body consists of a jelly-like substance, of irregular shape, from any part of which finger-like processes are at times protruded. It lives by absorption, and can improvise a stomach from any part of the exterior of its body. The Amœba is one of the very lowest forms of animal life. The lecturer then proceeded to explain the structure and habits of other microscopic animals, a little more complex than the preceding. Among these were the blue Stentor, the bell animalcule (*Vorticella*), the glutton (*Lurco*) Rotifers, or "wheel bearers," Paramœcium, the four-horned Cyclops, and other microscopic animals. He stated that he had frozen water, containing Rotifers, solid, and upon melting the ice the Rotifers were as lively as ever, also that they could endure a considerable degree of heat. A large diagram, with figures of the several plants and animals spoken of, materially helped to illustrate the paper, which will shortly appear *in extenso* in the next number of the *Canadian Naturalist*.—Mr. Billings then made a communication on the bones of a whale lately discovered at Cornwall, Ont., of which the following is an abstract:—"Several months ago Mr. Charles Poole, of Cornwall, wrote to the secretary of the Society that a large skeleton, resembling that of an Ichthyosaurus, had been found in that neighbourhood by the men engaged in excavating clay for brick. In another letter he stated that Mr. T. S. Scott, architect, of this city, had procured the lower jaws. On receipt of this information, Mr. Billings called upon Mr. Scott, who very liberally presented the jaws to the Geological Museum. Mr. Billings then went up to Cornwall and obtained from Mr. Poole the bones which were in his possession. These were discovered in the Post-pliocene clay formation, about sixteen feet below the surface. They are those of a small whale closely allied to the white whale, *Beluga leucas*, which lives in the Northern seas, and at certain seasons abounds in the Gulf and lower part of the St. Lawrence. The lower jaws are nearly per-

feet. The skull and upper jaws are much damaged, and some of the parts lost. Thirty-five of the vertebræ, the two shoulder blades, most of the ribs, and a number of small bones were collected. The length of the animal was probably about fifteen feet. The lower jaws have the sockets of eight teeth upon the right side, and of seven on the left. The number of teeth in the upper jaw could not be ascertained. In the head of a white whale belonging to the cabinet of M'Gill College, there are nine teeth in the right lower jaw, and eight in the left. The teeth of the fossil, judging from the size of the sockets, were longer than those of the white whale. In 1849, a small whale was discovered in Vermont about twelve miles south of Burlington, in a railway cutting, through a deposit of clay of the same formation as that of Cornwall. Judging from the figures and description published in *Silliman's Journal* by the late Professor Thompson, there can be little doubt that ours is the same species which he described, and which he called *Beluga vermontana*. Another specimen consisting of about half of the backbone, was discovered several years ago near the city of Montreal, and is now in the Museum of the Geological Survey. The locality at Cornwall is about half a mile from the railway station, sixty feet above the St. Lawrence, and over two hundred feet above the level of the sea.—The President, in inviting a discussion on the phenomena observed during the recent earthquake, said that there were records published or preserved of the appearances observed during 83 earthquakes in Canada and neighbouring parts of N. America. A severe shock was felt in Canada in 1860, an account of which might be found in the *Canadian Naturalist* for that year. Many of the phenomena noticed in 1870 were observed in the shock of 1860. Judging from the facts on record, there would seem to be a periodicity in earthquakes. They seem to occur much oftener in autumn and winter than in spring or summer, and between the 60th or 70th years of a century. On this ground he had stated that the shock of this year might prove to be the beginning of a series, if the law of periodicity holds good. A slight shock was, however, felt in Canada in the spring of 1864. The president next referring to the causes which produce earthquake, said that here there are no centres of active igneous agencies, as in Southern Italy and elsewhere. He suggested the idea that large masses of sediment are drained off by rivers from this continent and deposited on the Atlantic coast, and when, in addition to this, a pressure amounting to many millions of tons of atmospheric air is removed from the denuded portion, vibrations occur from long-continued tension of the earth's crust, and finally a break takes place. It was found that during the last earthquake the mercury in the barometer was an inch lower than the average. Dr. Smallwood gave a description of peculiar phenomena observed in the heavens before and after the earthquake. Among these were noticed several clusters of spots on the sun's disc in connection with peculiar auroral displays. He exhibited diagrams showing the barometrical and thermometrical appearances presented before and during the shock. During the continuance of the vibration the descent of the mercury was most marked in this respect, confirming Dr. Dawson's view. From telegrams received by the courtesy of Mr. Dakers, it would appear that the first shock was observed at Owen Sound, at 10.52 A.M. local time, and the latest at St. John's, N.B., at 11.45 A.M. local time. Accounts were received also from Toronto, Montreal, Quebec, and intermediate places. Judging from the accounts received, the extent of the vibration thus recorded would appear to have been from S.W. to N.E., and the shock to have occupied fifty-three minutes of time in traversing the 840 miles, without calculating for the difference of longitude between the places. This would give a rate of about sixteen miles per minute, but if the differences of longitude were calculated the rate would be about thirty-two miles per minute. This last estimate would agree nearly with that given by Humboldt and Mallet. The width or amplitude of the vibration, judging only by telegrams received by the speaker, would appear to have been some 340 miles. After some remarks by Dr. J. B. Edwards and others, the meeting adjourned.

Halifax, Nova Scotia

Institute of Natural Science, November 14.—J. M. Jones, F.L.S., president, in the chair. Rev. D. Honeyman, F.G.S., read a paper, entitled "Record of Observations on the Geology of Nova Scotia from 1855, Part I.;" from which it appeared that Dawson's "Acadian Geology," first edition, was published in 1855, and that in this work the author of the present paper was introduced as an explorer in the Nova Scotian field. His attention had been chiefly directed to the "Silurian (?) and Devonian rocks," so designated in that volume, and to the lower carboniferous conglomerates, grits, sand-stones, argillites, limestones, and gypsums. He had also made gleanings in the coal field. Since that period Dr. Dawson and the author, with the aid and advice of Sir R. Murchison, Hall, Salter, and Barrande, had deprived the Devonian system of its ascendancy in Middle and Eastern Nova Scotia, and Cape Breton; taking away the mark of interrogation from the Silurian and affixing it to the Devonian. This was done chiefly by a thorough investigation of the palæontology and geology of the thoroughly typical district of Arisaig on the south-east coast of Northumberland Strait, in the Gulf of St. Lawrence; and the application of this type to the geology of the province. It was shown by the author that while the fossils of the series of rocks of Arisaig had so great a resemblance to those of the British Silurian, that Mr. Salter could without hesitation designate the respective groups according to the British nomenclature; still, the series could be more satisfactorily and thoroughly compared with the Silurian of the United States; consequently, the Arisaig series were now arranged thus, in ascending order:—Oneida conglomerate, Medina sandstone, Clinton (Middle Silurian), Niagara limestone, Lowes Helderberg (Upper Silurian), Oriskany sandstone (?) (Devonian). In this locality these are overlaid unconformably by conglomerate with interstratified traps and limestones (Lower Carboniferous). The Silurian and Devonian (?) have been thrown into a synclinal by greenstone and amygdaloids of Lower Carboniferous age. The Arisaig fossiliferous series are bounded on the north by Northumberland Strait, on the south by mountains formed of another series of the same age, but different from the other in being highly metamorphic and, apparently, non-fossiliferous; the lowest member of the series is a *conglomerate* with cleavage. This series has been elevated by the upheaval of syenite. These conjointly attain to an elevation of from 1,000 to 1,010 feet above the sea level, according to Captain Bayfield's measurement; this being about the highest elevation of mountains in Nova Scotia. While numerous localities named in Dawson's "Acadian Geology," and others discovered by the author since 1855, have fossiliferous rocks of the Arisaig type, the general character of the rocks of the principal ranges of the mountains of Nova Scotia is Arisaig metamorphic non-fossiliferous. The President read a paper "On the Diurnal Lepidoptera of Nova Scotia, Rhopalogera, Part I." The following species were common in the province, *Papilio turnus* Linn.; *Pieris oleracea* Harris, *P. rapæ* Boisd., *Colias philodice* Godt., *Argynnis aphrodite* Fabr., *Argynnis myrina* Cram., *Melitæa tharos* Cram., *Grapta C. argenteum* Kirby, *Vanessa antiopa* Linn., *Pyrameis cardui* Linn., *P. huntera* Smith, *Nymphalis arthemis* Drury, *Erebia nephele* Kirby, *Satyrus alope* Fabr.; while *Danais archippus* Fabr., *Melitæa ismeria* Boisd., *Grapta interrogationis* Godt., *G. comma* Harris, *Vanessa J. album* Boisd., *V. milberti* Godt., *Pyrameis atalanta* Linn., *Nymphalis disippus* Godt., *Debis Portandia* Fabr., were rare. The author dwelt upon the introduction of *Pieris rapæ* into this part of the Canadian dominion within the last few years, and alluded to its abundance last summer in the neighbourhood of Halifax, where it did an immense amount of damage to the cauliflower crops. He mentioned the probable benefit that would arise from the introduction of the house-sparrow of England (*Pyrgita domestica*) that great enemy of caterpillar life, which would amply repay the trouble and expense of importation. At the present time the caterpillars were almost free from molestation, and it was but proper, when possible, on the introduction of an insect pest, to introduce also its known enemy. The author had observed that even in so small a country as Nova Scotia many species of butterflies were very local in distribution, and species quite common on one side of the province were altogether unknown on the other, although the distance between such positions was not more than thirty miles. Several Hesperians were yet unnamed, and these when identified with some Lycænians, would be included in Part II.

Wellington, New Zealand

Philosophical Society, September 17.—Dr. D. Hector exhibited a preparation showing the egg of the large Kivi (*Apteryx australis*) *in utero*. The bird had recently died in confinement, and was sent to the museum to be skinned. The egg, though full-sized, is soft, and squeezed out of shape by the pressure against the pelvic bones.—"Critical Notes on the Ornithological Portion of the Rev. R. Taylor's recent work on New Zealand."

by W. L. Buller, F.L.S.—"On the Ornamental Cultivation of Native Shrubs," by T. H. Potts and William Gray, Canterbury.—"Notes on New Zealand Birds," continued, by T. H. Potts.—"On the Nomenclature of New Zealand Rocks" and "Notice of some New Mineral Forms in the Museum," by E. H. Davis, F.L.S.—"On the Absorption of Sulphur by Gold," by W. Skey, Government analyst. The author of this paper, while recently investigating the causes of the reported loss of gold at the Thames gold fields during its extraction from the ore, found the gold is acted on by sulphuretted hydrogen, and thus a sulphide is formed which tarnishes the surface. Also that gold combines with free sulphur at a temperature of 212° Fahr. Gold thus sulphurised on the surface will not amalgamate with mercury. The loss of gold is not altogether due to the condition of the mercury, as has hitherto been supposed, as he has found this sulphide on the surface of native gold of every degree of purity.

VIENNA

I. R. Geological Institution, Sept. 30.—During the summer season the geologists of the Institution were partly occupied with the survey of Northern Tyrol from the environs of Kufstein, along the valley of the Inn westwards as far as Innsbruck, and partly on the military frontier between Barziasch on the Danube, and Brod in Slavonia. Messrs. Foetterle and Fr. v. Hauer, invited for this purpose by the Roumanian Government, investigated also parts of the Wallachian territory, and studied more particularly some sections between Bucharest and Kronstadt in Transylvania. Very interesting results were obtained here. The large portion of Southern Wallachia seems mostly covered with loess; but a boring at Bucharest, for an artesian well, perforated up to the depth of 250 metres beyond the loess nothing but strata of clay and sand, belonging to the Congeria-beds, a freshwater deposit which, in the Vienna basin, forms the highest member of the Miocene formation. Farther up towards the north the same strata constitute a broad zone of mountains of lower elevation, which board the plain, and form a passage to the high mountain which separates Wallachia from Transylvania. Large masses of petroleum are here imbedded in the lower parts of the congeria deposits. Whilst, therefore, the Galician petroleum belongs to the Eocene Carpathian sandstones, the Wallachian petroleum is of the upper Miocene age, and the strata which contain it abound in characteristic fossils of our congeria beds. Immediately below these beds follows the salt formation, consisting of salt clay, with large masses of rock salt, which is worked in the mines of Telega, Sylatina, Okna, &c. The higher mountains are formed chiefly of Eocene strata, partly sandstones, partly coarse conglomerates, with enormous boulders of jurassic limestone. These Eocene strata underlie immediately the salt formation in the Bucsecs mountain; they are upheaved to the height of more than 8,000 feet above the level of the sea. The crystalline rocks which form the nucleus of the Fogarasch mountains in Transylvania finish eastward in the neighbourhood of Ruckur, in the Dibmovizza-valley. On the passage between Kronstadt and Sinaja they are no longer to be observed.—Dr. T. Schmidt, director of the Observatory at Athens, gave notice of the violent earthquakes of July 31, August 1 and 5, in Greece, and mentioned that the volcanic eruptions in Santorin, which began five years ago, continue up to the present day with undiminished force.—M. Herbech discovered in Eastern Transylvania, on the Nagy-Hagymas mountain, some red limestone, with the characteristic fossils of the famous upper triassic Hallstatt marble, among them the magnificent Ammonites Metternichii.—Count H. Wilczek and Count G. Wurmbrand discovered last summer an old pile building (Pfahlbau) in the Atter Lake in Upper Austria, near Kammer. Stone implements, fragments of rough pottery, &c., were found in abundance at the bottom of the lake.

Imperial Academy of Sciences, October 6.—Professor Barth transmitted some communications from the Chemical Laboratory of the University of Innsbruck. These notices included the results of an investigation made by Prof. Barth on the reaction of fusing potash upon phenole, of an investigation of the bromophenolic acids, by M. Carl Tenhofer, and on some derivatives of gallic acid, by Professor Reynold.—Dr. S. von Basch presented a memoir on the first chyle-ducts and the absorption of fat. The results of the observations made at the Central Observatory for meteorology and terrestrial magnetism during the months of July and August were laid before the meeting.

October 13.—M. Julius Peterin communicated a memoir on the formation of electrical annular figures by the current of the influence machine.—Dr. L. J. Fitzinger presented the fifth section of his critical revision of the bat family, relating to the genera *Nyctiecjus*, *Lasiurus*, *Amblyotus*, *Murina*, *Harpyiocephalus*, *Nyctiptenus*, *Æorestes*, and *Natalus*.—Dr. von Zepharovich, of Prague, communicated a notice of the crystals of cerussite lately found in the Galena mines at Kirlibaba. His paper contained accurate measurements of the crystals.—Dr. E. Brücke communicated a paper by M. A. Schapringer on the contraction of the *tensor tympani*.—A memoir was read by Professor Loschmidt, containing an account of experimental investigations on the diffusion of gaseous mixtures, by M. A. Wretschke.—And Dr. J. Peyritsch communicated some further observations on pelorism in the Labiatæ.

DIARY

THURSDAY, DECEMBER 8.

ROYAL SOCIETY, at 8.30.—Report on Deep-Sea Researches carried on during the months July-September, 1870, in H.M. Surveying Ship *Porcupine*: Dr. Carpenter, F.R.S., and J. Gwyn Jeffreys, F.R.S.

SOCIETY OF ANTIQUARIES, at 8.30.—Autographs of Eminent Italian Princes: Dr. O'Callaghan, F.S.A.—On a Deed appointing Sir John Fastolf Governor of the Bastille, 3 Hen. V.: Mr. J. G. Nichols, F.S.A.

LONDON MATHEMATICAL SOCIETY, at 8.—Further Remarks on Quartic Surfaces: Prof Cayley.—On the Polar Correlation of two Planes, and its Connection with their Quadric Correspondence: Dr. Hirst, F.R.S.—On Systems of Tangents to Plane Cubic and Quartic Curves: Mr. J. J. Walker.—On the Order and Singularities of the Parallel of an Algebraical Curve: Mr. S. Roberts

LONDON INSTITUTION, at 7.30.—On Count Rumford and his Philosophical Work: Mr. W. Mattieu Williams.

FRIDAY, DECEMBER 9.

LIVERPOOL NATURALISTS' FIELD CLUB.—Lecture by Prof. W. C. Williamson, F.R.S.

SUNDAY, DECEMBER 11.

SUNDAY LECTURE SOCIETY, at 3.30.—On the Telescope and its Discoveries: Mr. R. A. Proctor.

MONDAY, DECEMBER 12.

LONDON INSTITUTION, at 4.—On Chemical Action (Educational Course): Professor Odling, F.R.S.

TUESDAY, DECEMBER 13.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

ETHNOLOGICAL SOCIETY, at 8.—On Stone Implements from Africa: Sir John Lubbock, Bart., M.P.—On Stone Implements from the Cape of Good Hope: Mr. Edgar Layard—Second Report on the Prehistoric Monuments of Dartmoor: Mr. C. Spence Bate.

PHOTOGRAPHIC SOCIETY, at 8.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY, at 7.

WEDNESDAY, DECEMBER 14.

SOCIETY OF ARTS, at 8.—On a new Method of producing Durable Mural Paintings by Fictile Vitrification: Mr. Alan S. Cole.

ROYAL MICROSCOPICAL SOCIETY, at 8.—On the Anatomy of *Ascarus lumbricoides*: Mr. B. T. Lowne, M.R.C.S.—Observations on the Aëroscope, or Air-dust Collector: Dr. Maddox.

THURSDAY, DECEMBER 15.

ROYAL, at 8.30.

CHEMICAL SOCIETY, at 8.—On some New Derivatives of Coumarin Mr. W. H. Perkin.

LINNEAN SOCIETY, at 8.

LONDON INSTITUTION, at 7.30.—On Count Rumford and his Philosophical Work: Mr. W. Mattieu Williams.

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ERRATA.—Page 76, first column, line 29 from bottom, for "high" read "low"; second column, line 8, insert after "winter," "—there atmospheric pressure is low;" page 92, second column, sixth note, for "Mr. Matthew Williams" read "Mr. William Mathews," and for "Mr. Williams" read "Mr. Mathews."